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APPEAL BRIEF

Applicant	:	Dohn J. Trempala
App. No	:	10/789,630
Filed	:	February 27, 2004
For	:	LOCKING CAP SYSTEM
Examiner	:	Suzanne Lale Dino Barrett
Art Unit	:	3676

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Robert J. Roby, Reg. No. 44,304

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Sir:

In accordance with the Notice of Appeal filed May 21, 2007, Applicant submits this Appeal Brief.

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I. REAL PARTY IN INTEREST

The real party in interest in this appeal is the assignee of the present application, The Knox Company ("Assignee"). Assignee is the owner of one-hundred percent interest in the present application as evidenced by an assignment recorded at Reel No. 010031, Frame 0873 by the Assignment Branch of the United States Patent and Trademark Office.

II. RELATED APPEALS AND INTERFERENCES

Other than the prior appeal filed on December 22, 2005, which resulted in the application being reopened by an Office Action mailed March 17, 2006 without an Examiner's Answer, Appellant, Appellant's legal representative and Assignee are unaware of any prior or pending appeal, interference or judicial proceeding that may be related to, that may directly affect, that may be directly affected by, or that may have a bearing on the Board's decision in the present appeal. Because of this lack of knowledge, no decisions are included in the appendix labeled RELATED APPEALS AND INTERFERENCES.

III. STATUS OF CLAIMS

Currently, the following status exists for each of the claims: Claims 1-7 stand rejected; Claims 8-23 have been cancelled; Claims 24-30 stand rejected; Claim 31 is allowed[1]; Claims 32 and 33 stand rejected; Claims 34 and 35 are objected to as depending upon rejected Claim 1; Claim 36 stands rejected; Claim 37 is objected to as depending upon rejected Claim 1; and Claim 38 stands rejected.

The rejections of Claims 1-7, 24-30, 32, 33, 36 and 38 are being appealed.[2]

[1] Claim 31 is not mentioned in the Office Action Summary but is specifically indicated as allowed on page 6 of the Office Action.
[2] The objection to Claim 28 is not being appealed.

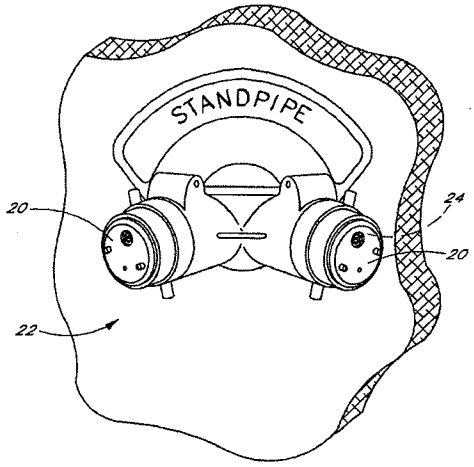
IV. STATUS OF AMENDMENTS

No amendments have been filed subsequent to the rejection. Therefore, the claims before the Board appear as they were rejected.

V. SUMMARY OF CLAIMED SUBJECT MATTER

To ease the understanding of the claimed subject matter, the following description will make reference to the published version of the application on appeal. The application was published on September 2, 2004 as United States Patent Application Publication No. 2004/0168488 A1. A copy of the publication is attached in the Evidence Appendix.

In general, the present inventions relate to a locking cap for a pipe end. In one preferred configuration, the present inventions relate to a locking cap that attaches to a fire department connection. Fire department connections are commonly found at standpipe locations alongside buildings, for instance. *See Figure 1 (reproduced to the right).* The standpipe locations are used for continuing to pump water through building sprinkler systems in the event of a fire following the initial burst of water maintained in the building's sprinkler systems.



As explained in the Background of the Invention, in particular at paragraphs [0006] through [0008], these fire department connections are often in easily accessed areas and, therefore, are often subject to vandalism or foolishness. If an individual were to place trash, rocks or the like in an unprotected fire department connection, use of the fire department connection would compromised at best and use of the fire department connection could destroy the associated sprinkler system at worst. Thus, certain aspects of the present inventions provide locking caps, and keys for use with such locking caps, whereby the locking caps can be locked in place within the fire department connection to secure the fire department connection until the fire department needs to remove the locking cap to recharge the sprinkler system during an actual emergency, for example.

As best shown in the exploded view of Figure 4, which is reproduced to the right, the illustrated locking cap 20 generally comprises a face plate 32 and a plug portion 38. *See [0031].* The face plate 32 comprises a front surface 86 and a rear or back surface 88. *See [0051].* The face plate 32 also can comprise at least two pins 94 that project from the front surface 86. In the illustrated embodiment, the two pins 94 are connected to the plug portion 38 via the face plate 32 such that the pins 94 can allow rotation of the plug portion 38 without facilitating expansion or contraction of the plug portion 38. *See [0052].* In other words, the plug portion 38 can be contracted and then, if difficult to turn, the pins 94 enable the plug portion 38 to be gripped or connected to a tool for rotation such that the cap 20 can be unscrewed from the fire department connection in which the cap 20 has been installed.

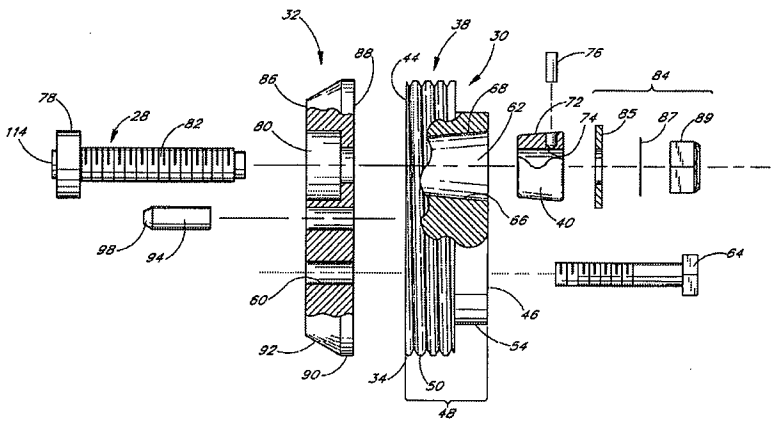
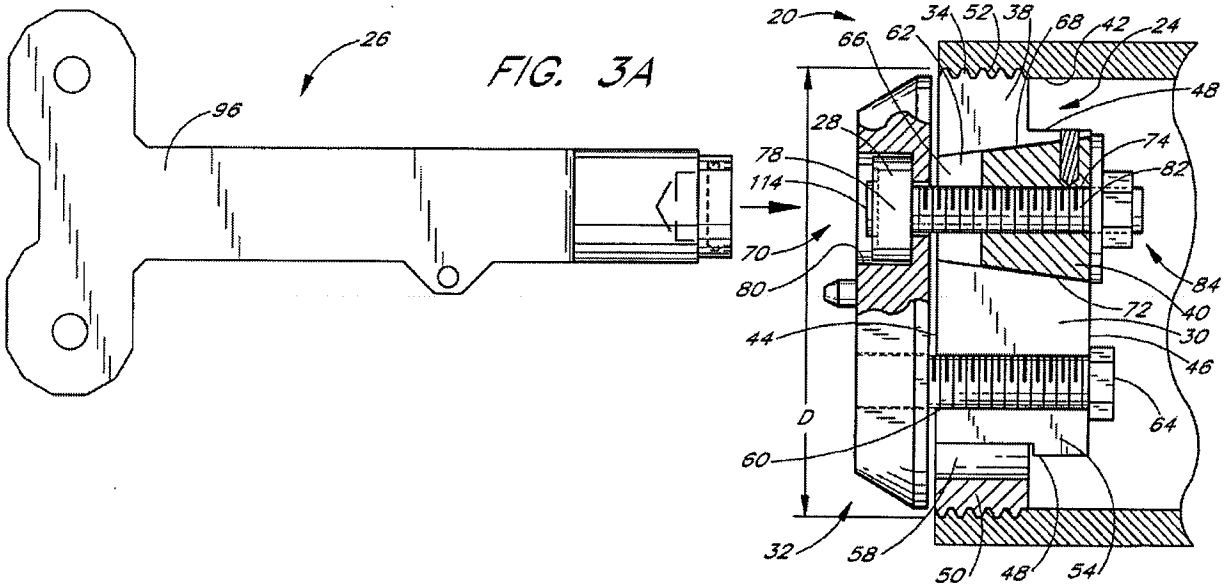
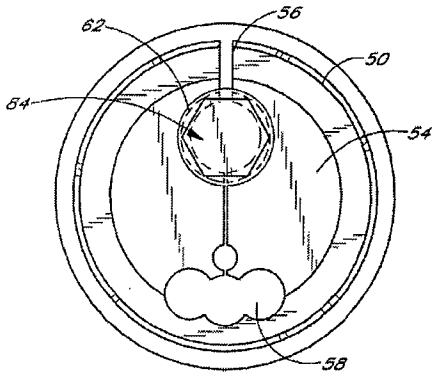


FIG. 3A



The face plate 32 can be connected to the plug portion 38. *See [0050].* The face plate 32 is connected to the plug portion 38 such that the back surface 88 of the face plate 32 is proximate



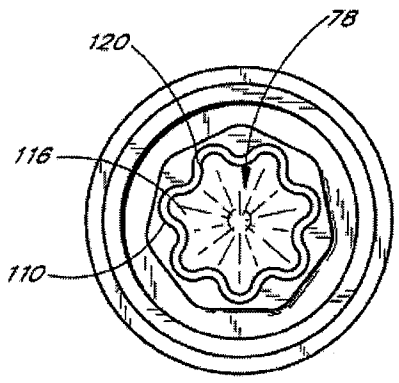
a surface of the plug portion 38. *See Figure 3A.* In illustrated preferred embodiment, the back surface 88 of the face plate 32 substantially faces a front surface 44 of the plug portion 38. *Id.*

The plug portion 38 has a front surface 44, a rear surface 46 and a side surface 48. *See [0036].* The plug portion 38 is sized and configured to be received within the pipe end with the side surface 48 of the plug portion 38 having a surface area generally coextensive with an inner contacted surface of the pipe. *Id.* In some configurations, the side surface 48 is threaded such that the plug 20 can be threaded into the pipe end. At least a portion of the plug portion 38 is capable of selective expansion and contraction to create a frictional interlock between the locking cap 20 and the pipe end. *Id.*

A slot 56 extends longitudinally between the front surface 44 and the rear surface 46 of the plug portion 38 while also extending radially between the side surface 48 and a relief opening 58 defined within the plug portion 38. *See [0040] and [0041].* A channel 66 is defined by a hole 62 through the plug portion 38 positioned along the slot 56. *See [0044].* The channel 66 is radially displaced from the relief opening 58. *See Figure 3B, which is reproduced to the left.*

The channel 66 receives a longitudinally translatable spreader member 40. *See [0044].* At least one surface of the spreader member 40 or the channel 66 is tapered such that the spreader member 40 and the channel 66 cooperate to expand and retract the plug portion 38. *Id.*

A key 26 also can be provided for locking and unlocking the locking cap 20. *See Figure 3A and [0055].* The key 26 comprises a head 100 and a handle 96. *Id.* In one configuration, the head 100 features a seven sided protrusion 110. *See Figure 7, which is reproduced to the right.* The head 100 advantageously is selectively engageable with a related structure on the locking cap 20. *Id.* The handle 96 preferably is configured to plastically deform when a level of torque exceeds a predetermined level of torque and the key 26 more preferably does not require a relief cut.



VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The first issue before the Board is whether the subject matter of each of Claims 1-4, 32, 36 and 38 is anticipated by U.S. Patent No. 5,419,650 issued to Hoshino.

The second issue before the Board is whether the subject matter of each of Claims 24-28 is anticipated by U.S. Patent No. 5,704,261 issued to Strauch.

The third issue before the Board is whether the subject matter of each of Claims 7 and 33 is rendered unpatentable by the combination of U.S. Patent No. 5,419,650 issued to Hoshino and U.S. Patent No. 4,651,771 issued to Borenstein.

The fourth issue before the Board is whether the subject matter of each of Claims 5 and 6 is rendered unpatentable by the combination of U.S. Patent No. 5,419,650 issued to Hoshino and U.S. Patent No. 6,017,177 issued to Lanham.

The fifth issue before the Board is whether the subject matter of each of Claims 24 and 29 is rendered unpatentable by the combination of U.S. Patent No. 5,033,501 issued to Stehling and U.S. Patent No. 5,704,261 issued to Strauch.

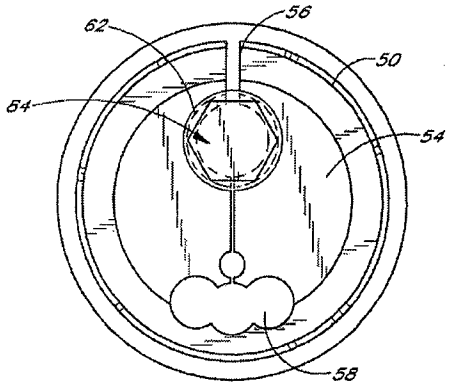
The sixth issue before the Board is whether the subject matter of each of Claims 24 and 30 is rendered unpatentable by the combination of U.S. Patent No. 4,651,771 issued to Borenstein and U.S. Patent No. 5,295,831 issued to Patterson.

The seventh issue before the Board is whether the subject matter of Claim 33 is properly rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as his invention.

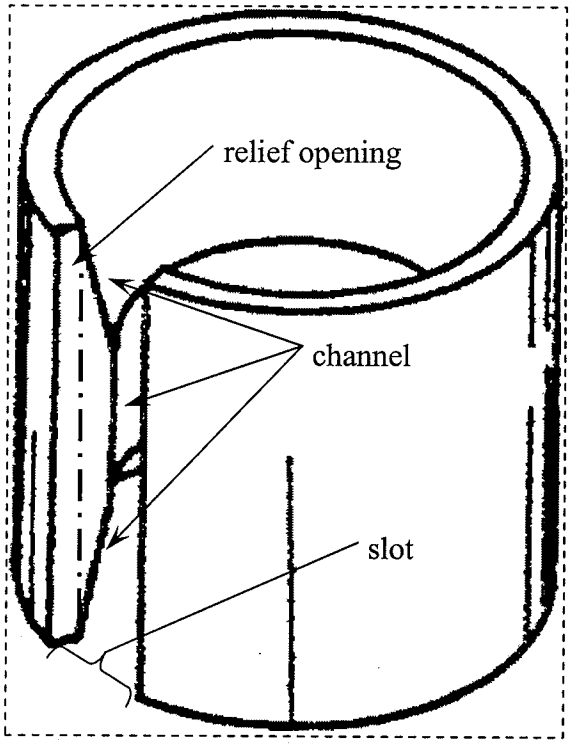
VII. ARGUMENT

Claims 1–4, 32, 36 and 38 Are Not Anticipated by Hoshino

Claims 1–4, 32, 36 and 38 stand rejected as anticipated by Hoshino (U.S. Patent No. 5,419,650); however, Hoshino did not disclose each limitation of the rejected claims.



Claim 1 is an independent claim. Claim 1 recites, among other limitations, (1) a slot that extends longitudinally (i.e., in an out of the paper in the image to the left) between a front surface of a plug portion and a rear surface of the plug portion; (2) a relief opening defined within the plug portion with the slot extending radially between a side surface of the plug portion and the relief opening; and (3) a channel defined through the plug portion along the slot and receiving a longitudinally translatable spreader member wherein at least one surface of the spreader member or the channel is tapered such that the spreader member and the channel cooperate to expand the plug portion. Claim 32 recites these limitations and also recites that the channel is radially displaced from the relief opening.



The Examiner has argued that Hoshino disclosed the slot, relief opening and channel. According to the Examiner, the "slot" is the gap that results in the otherwise closed cylindrical "plug" having an opening in the wall. According to the Examiner, in Figure 1 of Hoshino, the slot is identified with reference numeral 22 ("The plug comprises ... a slot 22 (fig. 1) extending longitudinally between the front [51a] and rear [21a] and radially between the side [at 21a in Fig. 1] and a relief opening (the top plane of slot 22 corresponding to the thickness of the wall of plug member 21, ie., the entrance of the open ended

slot).") Thus, the Examiner also considered the entrance of the open ended slot, which has a thickness of the thinnest part of the wall of the plug member, as defining the relief opening. Finally, the Examiner construed the channel to be defined by three surfaces (i.e., 23, 24 and 25).

While Applicant appreciates that the Examiner is supposed to give the claims their broadest reasonable construction, Applicant disagrees at the outset that this construction is reasonable. The Examiner is simply trying to assign terms in a manner that allows the Examiner to argue that the rejected claims are anticipated. The Examiner is ignoring the recited relationships between the claim terms, which will be discussed in further detail below.

Claims 1 and 32

Hoshino did not identically disclose every element of the rejected claims. See *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1990) (stating that the identical invention must be shown in as complete detail as is contained in the claim).

Claim 1 and Claim 32 each recites, among other limitations, a slot that is defined in two directions. First, the slot extends longitudinally between the front surface of the plug portion and the rear surface of the plug portion. Second, the slot extends radially between the side surface of the plug portion and a relief opening **defined within the plug portion**. Applicant does not understand how the Examiner's construction can result in a slot that extends radially from a side surface inward to a relief opening when the relief opening is defined as the thickness of the plug member. It would appear that the Examiner's construction results in a slot having a nonexistent thickness and that does not extend in a radial direction at all.

Claim 1 and Claim 32 also recites that the channel is defined **along the slot**. Thus, under the Examiner's strained construction, the channel somehow must extend along the slot even though the relief opening is defined between the slot and the surfaces that define the channel. Applicant submits that the Examiner's construction does not provide a channel that is defined along the slot.

Since Hoshino did not disclose, among other limitations, the limitations discussed above, Claims 1 and 32 are not anticipated by Hoshino. Accordingly, Appellant respectfully requests that the Board reverse the Examiner's rejection of Claims 1 and 32.

Claim 36

While Claim 36 also is not anticipated for the same reasons that Claim 1 is not anticipated, Claim 36 also recites, among other limitations, that the slot extends completely through the channel. In the illustrated embodiment, the slot extends completely through and appears beyond both sides of the channel. As explained above, under the Examiner's construction, the channel is the cylindrical center of the lumen. As such, the slot extends only to one side of the channel and extends along only a portion of the channel. Thus, under no construction consistent with the construction used to reject Claim 1 can the slot of Hoshino be argued to extend completely through the channel. For at least this additional reason, Hoshino did not anticipate Claim 36. Accordingly, Appellant respectfully requests that the Board reverse the Examiner's rejection of Claim 36.

Claims 2, 3, 4 and 38

Claims 2, 3, 4 and 38 ultimately depend from Claim 1 and each of these dependent claims is not anticipated for at least the same reasons as Claim 1 is not anticipated. Accordingly, Appellant respectfully requests that the Board reverse the Examiner's rejection of Claims 2, 3, 4 and 38.

Claims 24–28 Are Patentable Over Strauch

Claims 24–28 stand rejected as anticipated by Strauch et al. (U.S. Patent No. 5,704,261). Strauch did not disclose each limitation of the rejected claims.

Strauch disclosed a torque-exerting tool such as a screwdriver in which the shank section of the tool had a lower torsion spring constant than the working portion. There is no disclosure of a locking cap nor is there disclosure of a key for use with a locking cap.

Claims 24, 26 and 27

Claim 24 recites, among other limitations, a locking cap key for locking and unlocking a locking cap...the head selectively engageable with a related structure on the locking cap. Applicant submits that the preamble recitation of a locking cap key is a limitation on the claim and that a screwdriver is not a key. Thus, Strauch could not have anticipated Claim 24 under 35 U.S.C. § 102(b). Appellant respectfully requests that the Board reverse the Examiner's rejection of Claim 24.

Claims 26 and 27 depend from Claim 24 and are not anticipated by the applied reference for at least the same reasons that Clam 24 is not anticipated by the applied reference. Appellant respectfully requests that the Board also reverse the Examiner's rejection of Claims 26 and 27.

Claim 25

Claim 25 depends from Claim 24 and not anticipated by the applied reference for at least the same reasons that Claim 24 is not anticipated by the applied reference. Claim 25 also recites, among other limitations, that the handle be configured to plastically deform when a level of torque exceeds a predetermined level of torque required to lock the locking cap in position. Again, there is no disclosure of such a limitation in Strauch. Without the requisite disclosure, Strauch cannot anticipate Claim 25 under 35 U.S.C. § 102(b). Accordingly, Appellant respectfully requests that the Board reverse the Examiner's rejection of Claim 25.

Claim 28

Claim 28 depends from Claim 24 and is not anticipated by the applied reference for at least the same reasons that Claim 24 is not anticipated by the applied reference. Claim 28 also recites, among other limitations, that the related structure on the locking cap includes a recessed pattern that is complementary to the raised pattern recited by Claim 27. As explained above, there is no disclosure in Strauch of a locking cap. Without such a disclosure, Strauch cannot anticipate Claim 28. Appellant respectfully requests that the Board reverse the Examiner's rejection of Claim 28.

Claim 7 and Claim 33 Are Patentable Over the Combination of Hoshino and Borenstein

Claims 7 and 33 stand rejected as unpatentable over the combination of Hoshino and Borenstein (U.S. Patent No. 4,651,771). However, the Examiner has not established a prima facie case of obviousness. The Patent and Trademark Office has the burden under 35 USC 103 to establish a *prima facie* case of obviousness. *In re Piasecki*, 745 F.2d 1468, 1471-72, 223 USPQ 785, 787-87 (Fed. Cir. 1984). To establish a *prima facie* case of obviousness, three basic criteria must be met: first, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; second, there must be a reasonable expectation

of success; and finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *See M.P.E.P. § 2143.*

The Office Action states that "Hoshino teaches a plug member on a locking cap but fails to specify the material used." Borenstein is then combined with Hoshino to assert that the material from Borenstein, brass, can be combined with Hoshino, and in doing so, the combination allegedly renders Claim 7 obvious. Applicant respectfully submits that Claim 7 is patentable over this combination and that the combination is improper.

First, Claim 7 depends from Claim 1 and, not only does Hoshino not disclose several limitations, Hoshino does not teach or suggest at least those same limitations recited in Claim 1. Claim 33 also recites the limitations discussed above with respect to Claim 1. As Borenstein is only combined with Hoshino to establish a choice of material, the combination of Hoshino and Borenstein still lack a teaching or suggestion of all the limitations of Claim 1 and Claim 33 for the reasons set forth above. Accordingly, Claim 7 and Claim 33 should be allowed because of the failure of the combination to teach or suggest all of the recited limitations.

Second, if Hoshino and Borenstein are combined, the combination would be for the purpose of establishing a brass plug portion. The plug portion of Hoshino, however, is a thin-walled tube, and combining the references would necessarily result in a brass, thin-walled tube. The brass, thin-walled tube would necessarily yield too easily and would not return to a compressed state when the moveable member is retracted. Thus, the combination would render Hoshino unfit for its intended purposes. Applicant, therefore, respectfully submits that the combination of Hoshino and Borenstein is inappropriate as it would render the modified reference unfit for its intended purpose.

Claim 33 has also been rejected with the Examiner arguing that it would have been obvious to combine the teachings of Hoshino and Borenstein by providing a locking cap with the pipe cap expander arrangement taught by Hoshino on a fire department connection pipe taught by Borenstein as an obvious matter of design choice in substituting one type of pipe cap for another. As an initial matter, Applicant submits that Hoshino did not disclose a type of pipe cap – it disclosed a fastener used to secure planar objects to a pipe. Moreover, Hoshino disclosed a structure that was positioned and secured inside of a pipe end while Borenstein provided a structure that was positioned and secured outside of a pipe. The mechanisms used to secure a

structure outside of the pipe and inside of a pipe are vastly different. Furthermore, Borenstein sealed the pipe end while Hoshino did not. Thus, the two disclosed structures are not interchangeable. For these reasons as well, the rejection of Claim 33 is improper.

For at least these reasons, the subject matter of each of Claim 7 and Claim 33 is not rendered unpatentable by the combination of Hoshino and Borenstein. Accordingly, Appellant respectfully requests that the Board reverse the Examiner's rejections of Claim 7 and Claim 33.

Claims 5 and 6 Are Patentable Over the Combination of Hoshino and Lanham

Claims 5 and 6 stand rejected as unpatentable over the combination of Hoshino in view of Lanham (U.S. Patent No. 6,017,177).

Claims 5 and 6 depend from Claim 1, and as explained previously, Hoshino does not teach all the limitations recited in Claim 1. As Lanham is only combined with Hoshino to establish an allegedly similar key head, the combination of Hoshino and Lanham still lack a teaching or suggestion of all the limitations of Claim 1 for the reasons discussed above. Accordingly, Claims 5 and 6 are patentable over the applied combination and Appellant respectfully requests that the Board reverse the Examiner's rejection of Claims 5 and 6.

Claims 24 and 29 Are Patentable Over Stehling and Strauch

Claims 24 and 29 stand rejected as unpatentable over Stehling in view of Strauch. Stehling and Strauch are not properly combinable. Even if combined, Stehling and Strauch did not teach or suggest each limitation of the rejected claims.

Stehling taught a wrench that had multiple purposes: (1) removing a fire hydrant cap; (2) actuating a fire hydrant by manipulating the valve stem; (3) operating equipment on the truck. Accordingly, the same wrench was used for activities requiring varied levels of torque. There is no teaching or suggestion to configure the handle of the wrench to plastically deform when a level of torque exceeded a predetermined torque. Such a configuration would require that the level of torque be set to the greatest torque that the wrench needed to impart, regardless of whether that torque was in association with the cap, the valve stem or the equipment on the truck.

Strauch taught a torque-exerting tool such as a screwdriver in which the shank section of the tool had a lower torsion spring constant than the working portion. The shank was capable of

plastic deformation following an elastic deformation. Neither Strauch nor any other source provided any motivation to combine the two references.

The Examiner stated that "[i]t would have been obvious to one of ordinary skill in the art to modify the key of Stehling by providing a deformation zone as taught by Strauch et al as an obvious matter of design choice in enhancing the security of the lock cap." This asserted suggestion of the combination's desirability, however, has no justifiable basis. In this regard, Stehling says nothing about the need for to protect the cap from being over-tightened. Indeed, Stehling anticipates that, once tightened, actions taken by vandals may cause further tightening of the cap. Providing a deforming feature would compromise the ability to of the wrench of Stehling to remove caps. In addition, Strauch says nothing about using the deformation feature taught by Strauch in the environment of a locking cap – Strauch is only concerned with tool bits. Thus, nothing can be taken from either reference that would suggest incorporating Strauch's deforming feature with the wrench disclosed by Stehling.

Moreover, as explained at Col. 1, lines 53-56 of Stehling, the torque applied to the wrench is considerable. The cap would be installed using the wrench. See Col. 3, lines 7-11 of Stehling. Protecting the cap would require that the wrench deform when the torque applied during tightening exceeds the predetermined torque. However, if vandals attempt to remove the cap, the cap further tightens onto the fire hydrant. Thus, to remove the cap of Strauch, the allowable torque would necessarily have to be greater than the torque at which the wrench deformed during installation of the cap. Thus, to protect the cap by limiting installation torque with the special deforming wrench, the needed ability to render the cap removable in all emergencies would be compromised. For this additional reason, modifying the wrench of Stehling by providing a deformation zone as taught by Strauch would render the disclosed invention of Strauch unusable for its intended purpose and, therefore, such a modification would not be proper. See *M.P.E.P. 2143.01(citing In re Gordon,* 733 F.2d 900, 221 USPQ 125 (Fed. Cir. 1984)).

For at least these reasons, the combination of Stehling and Strauch is not proper and Claims 24 and 29 are properly patentable. Appellant respectfully requests that the Board reverse the Examiner's rejections of Claims 24 and 29.

Claims 24 and 30 Are Patentable Over Borenstein and Patterson/Strauch

Claims 24 and 30 stand rejected as unpatentable over Borenstein in view of Patterson according to the introduction of the rejection although the Examiner appears to rely upon Strauch in the body of the rejection. The references, however, do not teach or suggest each limitation of Claims 24 and 30. See *M.P.E.P. 2142 (the prior art reference (or references when combined) must teach or suggest all the claim limitations).*

Borenstein taught a wrench for use with a fire hydrant protective cap. Patterson taught a disposable torque wrench for dental components. The torque wrench of Patterson requires a relief cut to ensure that the wrench will yield as described by the patent. As discussed above, Strauch simply taught a screwdriver bit with a deformation zone formed of a material having differing properties relative to the remainder of the screwdriver bit.

Claim 24 recites, among other limitations, that the locking cap keys do not include a relief cut, as required by Patterson, and that the handle is configured to plastically deform when a level of torque exceeds a predetermined level. Strauch, to the contrary, did not teach a deforming handle but the tool bit itself deformed. Applying such a teaching, without the benefit of hindsight, to Borenstein would have led one to have a deforming region at the plug portion 50 and recessed portion 66. Most likely, given that one side of the wrench is for the cap (i.e., the plug portion 50) while the other side of the wrench (i.e., the recessed portion 66) is for actuating the valve stem, the plug portion 50 might have been made to deform such that the ability of the handle to transmit the needed torque for the valve stem would not be compromised. Accordingly, Applicant respectfully submits that no applied reference taught or suggested a handle that was configured to plastically deform when a level of torque exceeded a predetermined level of torque and where the key did not require a relief cut. Without such a teaching, Claim 24 is properly patentable over the applied combination.

Claim 30 recites, among other limitations, that the key comprises a generally T shaped configuration with a narrow arm portion and a cross member and where the cross member has at least one hole disposed therein. None of the applied references teach such a configuration. There is no hole in the wrench of Borenstein and there is no hole in the screwdriver bit of Strauch. Without such a teaching, Claim 30 is properly patentable over the applied combination.

Appellant respectfully requests that the Board reverse the Examiner's rejection of Claims 24 and 30.

Claim 33 Is Definite

Claim 33 has been rejected as indefinite. The Examiner states that it is unclear whether the intent is to claim the combination of a locking cap and a fire department connection or the locking cap alone. Applicant submits that, when the claim is viewed as a whole, the claim reasonably apprises one of its scope. See *M.P.E.P. 2173.02.*

Claim 33 has been written such that the preambular recitation of "fire department connection" limits that structure of the locking cap in that the locking cap must be "sized and configured to be received by the pipe end of the fire department connection." Applicant has clearly expressed that Claim 33 does not positively recite a fire department connection because Applicant intends to protect a locking cap that is specific to such an application in Claim 33.

Use of "sized and configured to be received by the pipe end of the fire department connection" does not positively recite the fire department connection but does make the body of the claim depend upon the preamble for completeness. Moreover, the intended use recited in the preamble in combination with the recitation within the claim serves to limit the size and shape of the locking cap such that intended use results in a structural difference between the claimed invention and the prior art. As such, the preamble serves to further define the structure of the recited "locking cap" and the format of the claim is definite as written. Applicant submits that Claim 33 is definite.

VIII. CLAIMS APPENDIX

1.**(Original)** A locking cap for a pipe end, the locking cap comprising a face plate and a plug portion, the face plate having a front surface and a rear surface, the plug portion having a front surface, a rear surface and a side surface, a slot extending longitudinally between the front surface and the rear surface and radially between the side surface and a relief opening defined within the plug portion, a channel defined through the plug portion along the slot, the plug portion connected to the face plate with the rear surface of the face plate arranged to substantially face the front surface of the plug portion, the plug portion sized and configured to be received by the pipe end with the side surface of the plug portion having a surface area generally coextensive with an inner contacted surface of the pipe end, the channel receiving a longitudinally translatable spreader member wherein at least one surface of the spreader member or the channel is tapered such that the spreader member and the channel cooperate to expand and retract the plug portion.

2.**(Original)** The locking cap of Claim 1 further comprising an actuator mechanism, the actuator mechanism having an actuator shaft which extends through the channel and is engaged with the spreader member such that as the actuator shaft rotates within the channel the spreader member translates within the channel.

3.**(Original)** The locking cap of Claim 2, wherein the actuator shaft has an actuator head portion, the actuator head portion being selectively engageable with a key head portion such that the key head portion selectively causes the actuator to rotate.

4.**(Original)** The locking cap of Claim 3, wherein the actuator head portion has a female pattern and the key head portion has a male pattern that is complementary to the female pattern.

5.**(Original)** The locking cap of Claim 4, wherein the female pattern is a cloverleaf consisting of seven apexes and eight wavy grooves interconnecting the seven apexes.

6.**(Original)** The locking cap of Claim 4, wherein the female pattern comprises at least five apexes.

7.**(Original)** The locking cap of Claim 1, wherein the plug portion is formed from brass.

24.**(Previously Presented)** A locking cap key for locking and unlocking a locking cap, the key comprising a head and a handle, the head selectively engageable with a related structure

on the locking cap and the handle being configured to plastically deform when a level of torque exceeds a predetermined level of torque, and wherein the key does not require a relief cut.

25.**(Original)** The locking cap key of Claim 24, wherein the predetermined level of torque exceeds that required to lock the locking cap in position.

26.**(Original)** The locking cap key of Claim 24, wherein the key assumes a permanently set spiral twist as a result of the plastic deformation.

27.**(Original)** The locking cap key of Claim 24, wherein the head has a raised pattern disposed on a distal tip of the head.

28.**(Previously Presented)** The locking cap key of Claim 27, wherein the related structure on the locking cap includes a recessed pattern and the raised pattern of the locking cap key is complementary to the recessed pattern.

29.**(Original)** The locking cap key of Claim 24, wherein the handle includes a hanging ring.

30.**(Original)** The locking cap key of Claim 24, wherein the key has a generally T shaped configuration comprising a narrow arm portion and a cross-member, the cross-member having at least one hole disposed therein.

32.**(Previously Presented)** A locking cap for a pipe end, the locking cap comprising a face plate and a plug portion, the face plate having a front surface and a rear surface, the plug portion having a front surface, a rear surface and a side surface, a slot extending longitudinally between the front surface of the plug portion and the rear surface of the plug portion and radially between the side surface of the plug portion and a relief opening defined within the plug portion, a channel defined through the plug portion along the slot and radially displaced from the relief opening, the plug portion being connected to the face plate with the rear surface of the face plate arranged to substantially face the front surface of the plug portion, the plug portion sized and configured to be received by the pipe end with the side surface of the plug portion having a surface area generally coextensive with an inner contacted surface of the pipe end, the channel receiving a longitudinally translatable spreader member wherein at least one surface of the spreader member or the channel is tapered such that the spreader member and the channel cooperate to expand and retract the plug portion.

33.**(Previously Presented)** A locking cap for a fire department connection, the fire department connection locking cap comprising a face plate and a plug portion, the face plate of the fire department connection locking cap having a front surface and a rear surface, the plug portion of the fire department connection locking cap having a front surface, a rear surface and a side surface, a slot extending longitudinally between the front surface and the rear surface and radially between the side surface and a relief opening defined within the plug portion, a channel defined through the plug portion along the slot, the plug portion connected to the face plate with the rear surface of the face plate arranged to substantially face the front surface of the plug portion, the plug portion of the fire department connection locking cap sized and configured to be received by the pipe end of the fire department connection with the side surface of the plug portion having a surface area generally coextensive with an inner contacted surface of the pipe end of the fire department connection, the channel receiving a longitudinally translatable spreader member wherein at least one surface of the spreader member or the channel is tapered such that the spreader member and the channel cooperate to expand and retract the plug portion.

34.**(Previously Presented)** The locking cap of Claim 1, wherein the channel intersects only a portion of the slot.

36.**(Previously Presented)** The locking cap of Claim 1, wherein the slot extends completely through the channel.

38.**(Previously Presented)** The locking cap of Claim 1, wherein the channel and the slot extend completely through the plug portion.

IX. EVIDENCE APPENDIX

1. The Present Application as Published (United States Publication No. 2004/0168488A1) – pages 23-37.
2. United States Patent No. 5,419,650, Issued to Hoshino, Applied in Office Action mailed November 20, 2006 – pages 38-50.
3. United States Patent No. 4,651,771, Issued to Borenstein, Applied in Office Action mailed November 20, 2006 – pages 51-56.
4. United States Patent No. 6,017,177, Issued to Lanham, Applied in Office Action mailed November 20, 2006 – pages 57-66.
5. United States Patent No. 5,704,261, Issued to Strauch, Applied in Office Action mailed November 20, 2006 – pages 67-72.
6. United States Patent No. 5,033,501, Issued to Stehling, Applied in Office Action mailed November 20, 2006 – pages 73-81.
7. United States Patent No. 5,295,831, Issued to Patterson, Applied in Office Action mailed June 24, 2005 – pages 82-88.
8. Office Action Mailed November 20, 2006 – pages 89-102.

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Trempala (43) **Pub. Date: Sep. 2, 2004**

(54) **LOCKING CAP SYSTEM**

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(60) Provisional application No. 60/074,156, filed on Feb. 9, 1998.

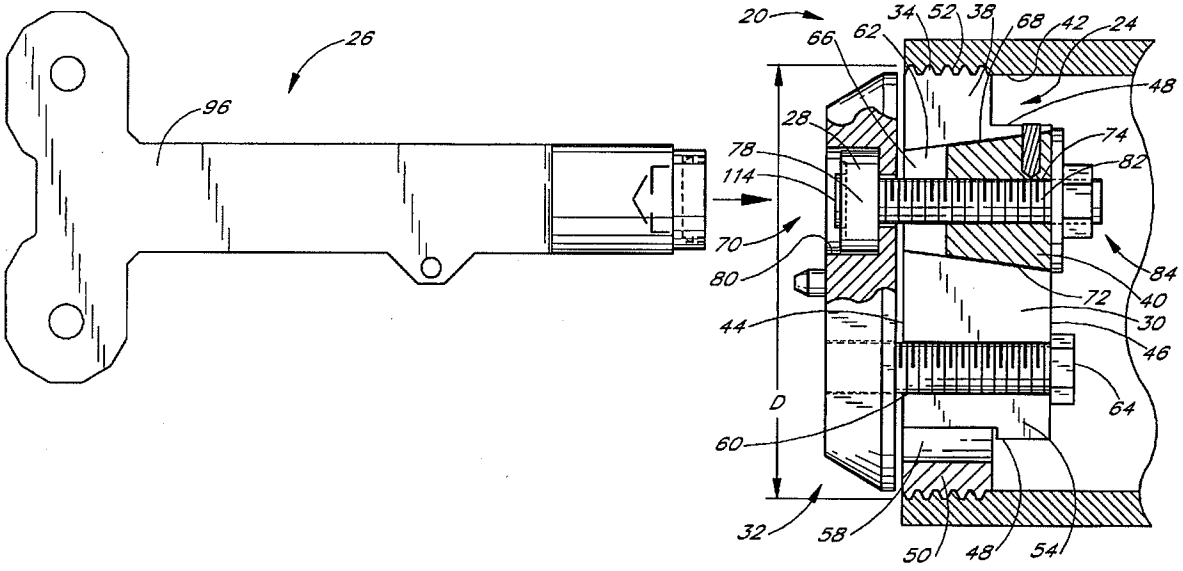
Publication Classification

(51) **Int. Cl.**[7] **B65D 55/14**

(52) **U.S. Cl.** **70/169**

(57) **ABSTRACT**

A locking cap is selectively locked into place within a tubular opening, such as the open end of a standpipe used to charge a building sprinkler system. The locking cap has an expandable sleeve and a spreader member. As a key is turned, the spreader member is drawn into the expandable sleeve which is urged outward. The outward movement of the expandable sleeve increases a frictional component such that the expandable sleeve becomes frictionally locked within the tubular opening. The key has an end design that is complemented by an end of an actuator shaft such that the likelihood of unauthorized removal of the locking cap is reduced.



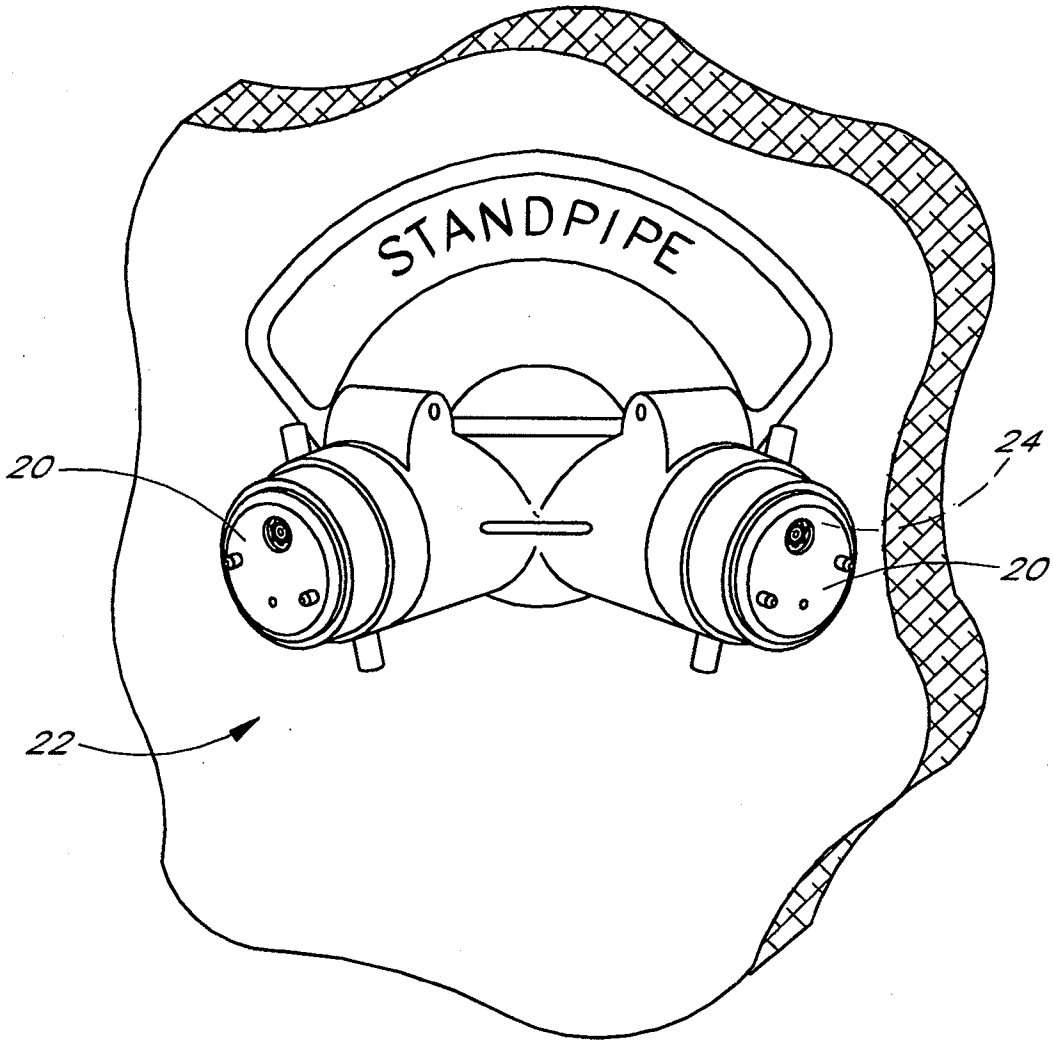


FIG. 1

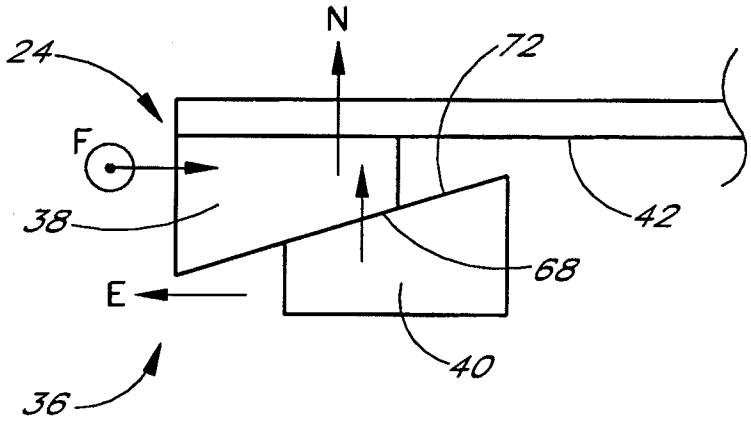


FIG. 2

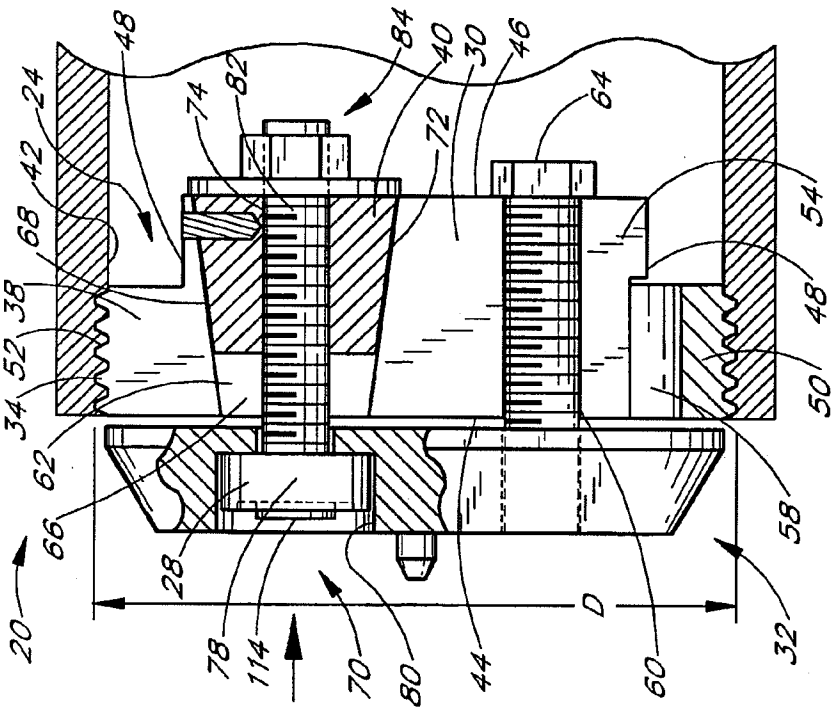

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FIG. 3A

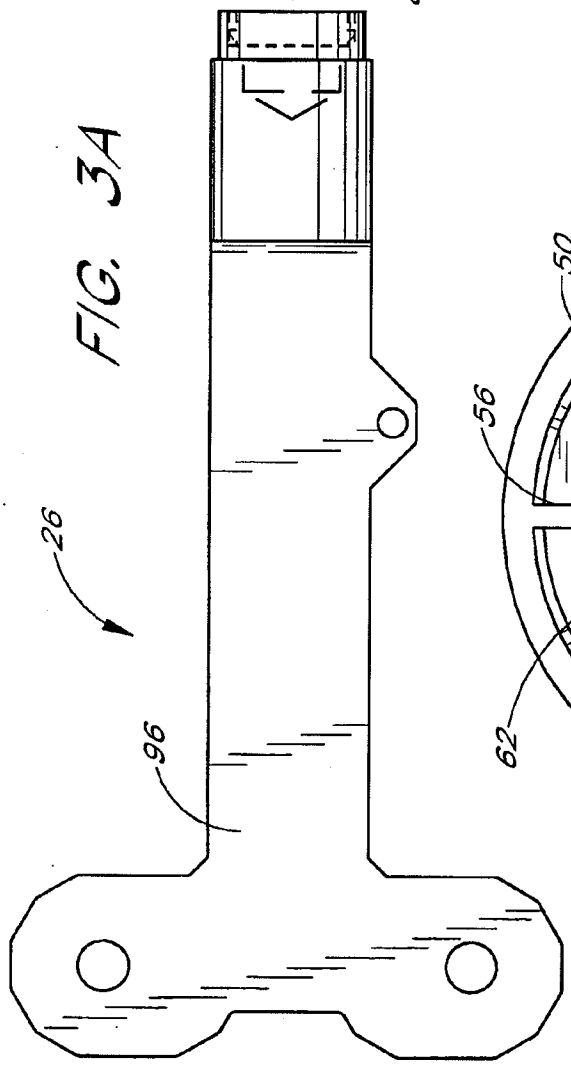
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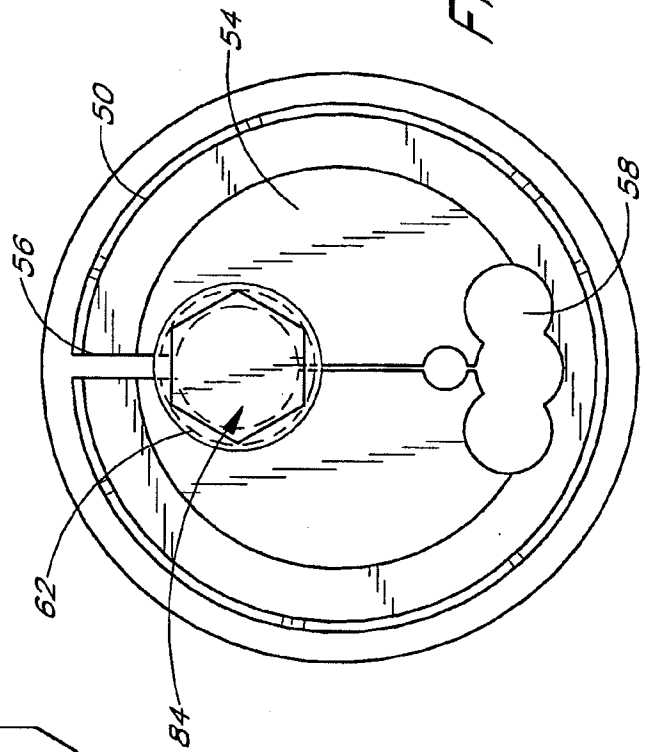
FIG. 3B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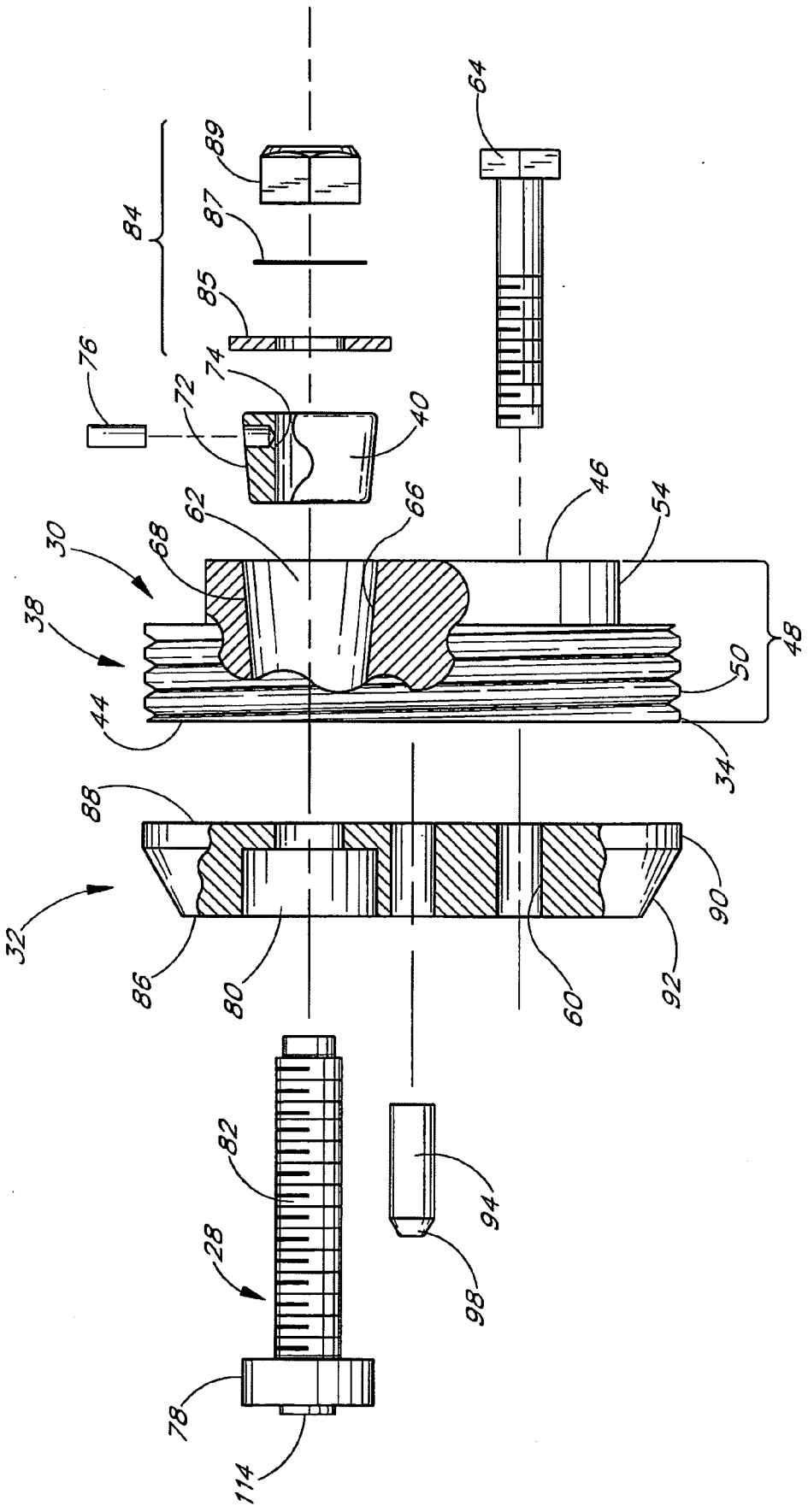
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FIG. 4

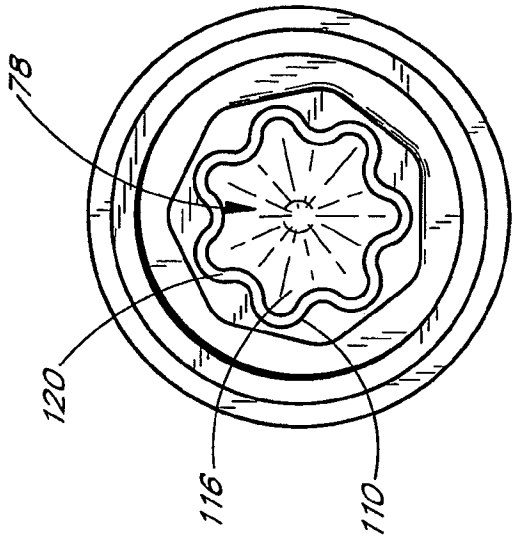

FIG. 7

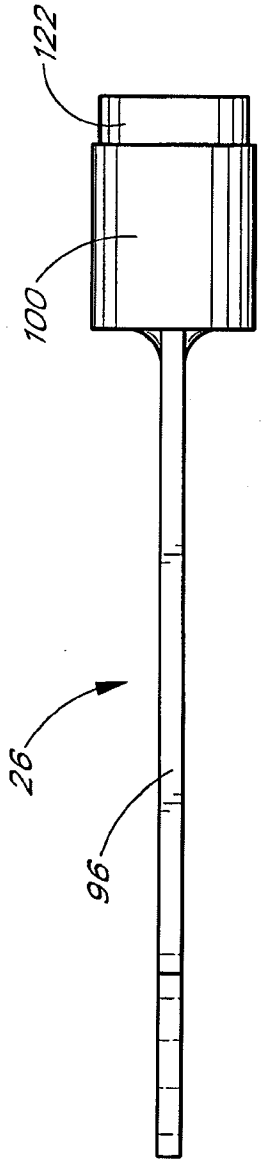

FIG. 5

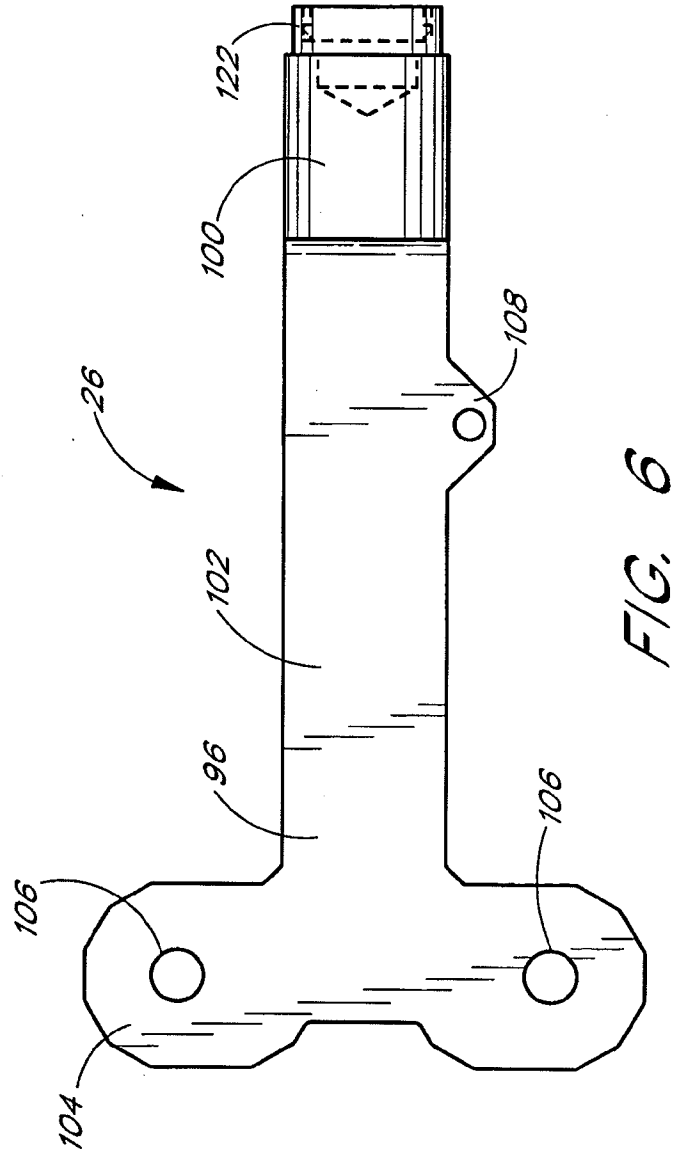

FIG. 6

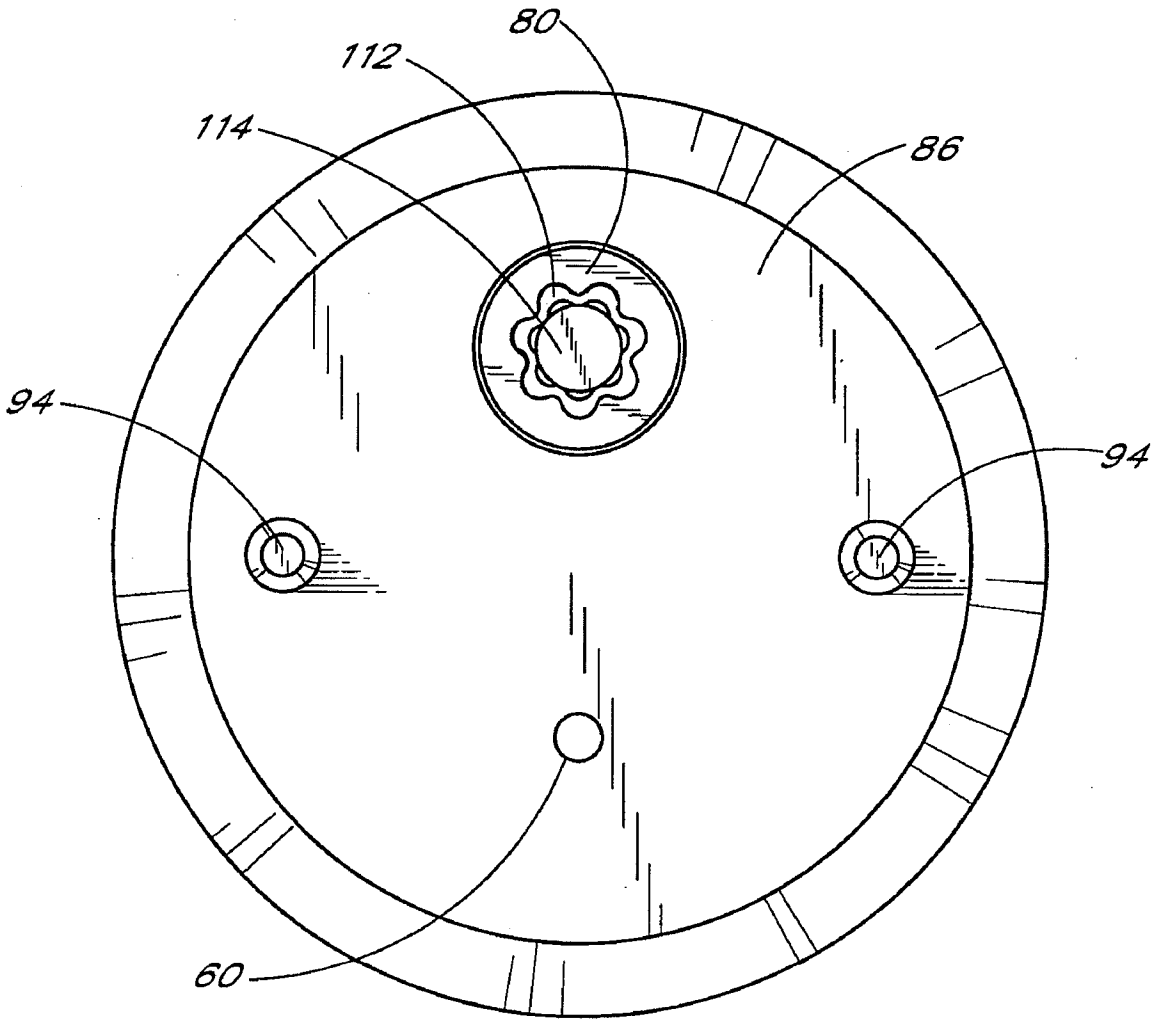

FIG. 8

LOCKING CAP SYSTEM

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of U.S. application Ser. No. 10/273,894, filed Oct. 17, 2002 which is a continuation of U.S. application Ser. No. 09/247,665, filed on Feb. 9, 1999 now U.S. Pat. No. 6,487,882, issued Dec. 3, 2002, which claims priority from U.S. Provisional Application No. 60/074,156, filed on Feb. 9, 1998.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention generally relates to a locking cap and key combination for open ends of plumbing components and, more specifically, to a protective locking cap and key combination for threaded openings in couplings, fixtures and the like. Even more specifically, the present invention relates to a locking cap and key combination for fire retardant sprinkler systems utilizing charging pipes.

[0004] 2. Description of the Related Art

[0005] In fire protection systems that include automatic sprinkler systems having multiple sprinkler heads, the standing water supply is often not sufficient to maintain optimum operating water pressure when there are several sprinkler heads in simultaneous operation. Accordingly, the National Fire Protection Association Code requires a connection through which a fire department can pump water into the sprinkler system in order to charge or recharge the sprinkler system. Where such connections are provided, upon arrival of fire department personnel, an auxiliary source of water supply, usually a hose supplied with water from a fire truck pump, may be connected to a union connection advantageously located outside the building. Such hose connections are often termed siamese connections and are fitted with union nuts having an internal thread sized and configured to match the external thread of the hose of the local fire department. Also, in most instances, the union nut is loosely retained on the inlet pipe through a bearing arrangement and is provided with radially extending parts adapted to be operated by a "spanner" wrench carried by most firefighters.

[0006] The National Fire Protection Association Code also specifies that such hose connections shall be equipped with plugs or caps. Because the hose connections are in public locations which may be unsecured, the plugs or caps are desired to reduce the likelihood that passersby, vandals, or arsonists will damage the connections and render the connections inoperable. Thus, the plugs or caps cover the auxiliary water inlet to the sprinkler system to prevent malicious introduction of trash or other debris. Such trash and debris might clog the sprinkler system when it is needed most.

[0007] Several types of caps or plugs have heretofore been provided to cover the union nut of siamese connections and protect the integrity and operability of the sprinkler system. One such arrangement includes an easily breakable cap, made of cast iron for example, which cap is attached to the union nut by U-bolts carried by the cap but adapted to engage the posts of the union nut to hold the cap in place. Such cap members have been particularly vulnerable to vandalism and are particularly susceptible to breakage at the points where the U-bolts are received in the cap. Furthermore, even where the cap is not broken, certain portions of the cap rust through over time and the caps simply fall off. In addition, because of the differences in coefficients of thermal expansion between the union nut and the cap, the cap is also susceptible to breakage.

[0008] Another common device is a brass plug having external threads to be received in the union nut where the plug, like the union nut, is provided with radially extending posts to be operated by a spanner wrench. The union nut of such siamese connections is usually brass so it is necessary to provide brass plugs, which are of substantial scrap value. Accordingly, because of their location in often unsecured public places, the plugs are frequently stolen for resale as scrap.

[0009] Summary of the Invention

[0010] Accordingly, a locking cap is desired for a standpipe that can be securely mounted so that it is not easily removed by unauthorized personnel. Additionally, such a locking cap desirably is quickly removed by authorized personnel under time pressures and mental anxiety. Moreover, such a locking cap should be relatively impervious to climatic elements such that deterioration over time is reduced.

[0011] Thus, the present invention provides a locking cap and key combination that is virtually tamperproof such that it cannot be removed without substantial destruction thereof, but which is not susceptible to inadvertent breakage. Moreover, the locking cap is easily removed at the appropriate time by authorized personnel utilizing a specially designed mating key arrangement. Furthermore, another aspect of the present invention provides a straightforward cap design which is easily and economically fabricated, and which is easily attached to secure a fire sprinkler system.

[0012] One feature of the present invention is the universal nature of the key and locking cap. While it is advantageous to prevent vandals and the like from removing the locking cap, the locking caps are configured with a unique locking mechanism which allows the fire department, or other authorized personnel, to use a single key to unlock every locking cap within their jurisdiction. This capability may prove important during crisis situations requiring rapid response. Specifically, the use of a single key eliminates the need to rifle through a variety of keys to find the proper key to remove the subject locking cap. Additionally, the locking caps may be serialized to empower a fire department or other entity with an ability track their location in the event of a lost, stolen or otherwise transferred locking cap.

[0013] One aspect of the present invention involves a locking cap for a pipe end. The locking cap has a faceplate and a plug portion. The faceplate has a front surface and a rear surface while the plug portion has a front surface, a rear surface and a side surface. A slot extends longitudinally between the front surface and the rear surface and radially between the side surface and a relief opening. Additionally, a channel is defined along the slot proximate the side surface. The plug portion is connected to the faceplate with the rear surface of the faceplate arranged to substantially face the front surface of the plug portion. Moreover, the plug portion is sized and configured to be received by the pipe end. The channel receives a translatable spreader member

wherein at least one surface of the spreader member or the channel is tapered such that the spreader member and the channel cooperate to expand and retract the plug portion.

[0014] Another aspect of the present invention involves a locking cap for a tubular opening. The locking cap generally comprises a cap body having an expansion member and a spreader member. The expansion member and the spreader member include a sloping engagement face such that relative axial movement of the expansion member and the spreader member results in radial displacement of at least a portion of the expansion member. The radial displacement of the portion of the expansion member urges the expansion member into a frictional interlock with an inner surface of the opening.

[0015] Yet another aspect of the present invention involves a locking cap for a pipe end generally comprising a faceplate. The faceplate includes a front surface and at least two pins projecting from the front surface. The faceplate also has a back surface and is connected to a plug portion such that the back surface of the faceplate is proximate a surface of the plug portion. At least a portion of the plug portion is capable of selective expansion and contraction to create a frictional interlock between the locking cap and the pipe end.

[0016] Another aspect of the present invention involves a lockable closure for an open end of a tubular element. The closure generally comprises a radially expanding member and an actuator shaft. The actuator shaft has a first end and a second end with the first end of the actuator shaft having a keyed configuration. The second end of the shaft extends through the closure into the tubular element. The actuator shaft is rotatable relative to the closure and is connected to the radially expanding member such that rotation of the actuator shaft in one direction effects generally outward movement of the radially expanding member and rotation of the actuator shaft in the other direction effects generally inward movement of the radially expanding member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] These and other features, aspects and advantages will now be described with reference to drawings of a particular preferred embodiment which is intended to illustrate and not to limit the present invention and in which:

[0018] **FIG. 1** is a perspective illustration of an exemplary standpipe connection having locking caps configured according to certain aspects of the present invention and having standard over caps hanging by chains from the standpipe connection;

[0019] **FIG. 2** is a schematic illustration of a frictional interlock having features, aspects and advantages in accordance with the present invention;

[0020] **FIG. 3A** is a partially sectioned side view of a locking cap and key combination having features, aspects and advantages in accordance with the present invention, with the locking cap inserted within a pipe but not locked therein;

[0021] **FIG. 3B** is a rear view of the locking cap of **FIG. 3A** illustrating an interstitial slot and a relief slot;

[0022] **FIG. 4** is a partially sectioned exploded side view of the locking cap and key combination of **FIG. 3A**;

[0023] **FIG. 5** is a top view of the key of **FIG. 3A**;

[0024] **FIG. 6** is a side view of the key of **FIG. 3A**;

[0025] **FIG. 7** is an end view of the key of **FIG. 3A**; and

[0026] **FIG. 8** is a front view of the locking cap of **FIG. 3A** illustrating the actuator bolt head of the locking cap.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0027] With reference initially to **FIG. 1**, a locking cap **20** is illustrated in engagement with a standard standpipe **22** connection. The pipe ends have internal threads for attaching fire hoses or the like. The illustrated locking caps are secured within the pipe end in engagement with the internal threads of the pipe ends and may be covered by the standard caps if desired. However, the illustrated locking caps preferably replace the standard caps. The illustrated standpipe **22** provides an exemplary environment for the locking cap and key combination having certain features, aspects and advantages in accordance with the present invention. Specifically, the present locking cap and key combination is designed to protect fire sprinkler system standpipe openings **24**, or other similar openings, from debris which may be maliciously inserted into the openings and which may then damage or plug the associated sprinkler system when the system is charged during use.

[0028] It is understood, however, that a locking cap and key combination having features, aspects and advantages in accordance with the present invention may also find utility in a variety of other contexts. For instance, but without limitation, the locking cap **20** may protect valves, pipes, connections, fittings and various other components having an open end subject to tampering or unauthorized access. Such components may be used in industries such as, for example but without limitation, those related to petrochemicals, chemicals, pharmaceuticals, and food or dairy processing. For instance, a locking cap may provide a way of securing an open pipe end in a petroleum line that may reduce or eliminate unauthorized access to such an opening **24**.

[0029] With continued reference to **FIG. 1**, in use, the locking cap **20** is inserted into an open end **24** of a pipe, valve, connection, fitting or other similar component. In some embodiments, the locking cap **20** may be slid into place or it may be rotated into place via threads. Notably, as will be discussed below, the locking cap **20** configured in accordance with various aspects of the present invention may either fit over or within the opening **24**. Once in place, a key **26** (see **FIG. 3A**) is used to lock the locking cap **20** in position. Various locking mechanisms may be used; however, a presently preferred expanding axial friction interlock will be described in detail below. When access to the opening **24** is desired or required, the key **26** may be used to quickly unlock the locking cap **20** and the locking cap **20** may then be easily removed. However, when the locking cap **20** is locked in place, the locking cap **20** resists removal and thereby protects the opening **24** from malicious debris insertion or accidental leaks while also protecting the locking cap **20** from theft or vandalism.

[0030] With continued reference to **FIG. 1**, the illustrated locking cap **20** provides a selectively lockable closure for the opening **24** of an end of a pipe. As will be discussed in

detail below, the associated key **26** may be custom manufactured in a nonstandard pattern, may be purchased from commercial suppliers such as McGuard, or may simply be a standard tool, such as, for example but without limitation, an allen wrench, a square socket or the like. The illustrated key **26** is designed for use with a lock actuator bolt **28**, which is described in detail below and may be manufactured by suppliers such as McGuard. Thus, the key **26** and the lock actuator bolt **28** are desirably formed as a matching lug and socket combination.

[**0031**] With reference to **FIG. 3**A, the illustrated locking cap **20** generally comprises a plug portion **30** and a faceplate **32**. While the plug portion **30** of the illustrated locking cap **20** is sized and configured for insertion into the pipe end opening **24** or other similar opening, it is envisioned that certain aspects of the present invention may also be used with externally positioned caps, as will be described more fully below. Additionally, while the illustrated plug portion **30** desirably has external threads **34** along a portion thereof, other non-threaded configurations may also have features in accordance with the present invention. Accordingly, as used herein, the term "cap" includes both a covering cap and an insertion plug. Additionally, an "opening" of an environmental structure shall mean the open end of a pipe, connection, valve, fitting and the like.

[**0032**] With reference now to the schematic illustration of **FIG. 2, a** locking mechanism **36** having features, aspects and advantages in accordance with the present invention will now be introduced and described. The illustrated locking arrangement generally comprises an expansion member **38** and a spreader member **40**. The expansion member **38** and the spreader member **40** cooperate to selectively urge the expansion member **38** outward into abutment with an inner wall **42** of an opening **24**. While the illustrated expansion member **38** is positioned closer to the pipe end, it is anticipated that the relative positions of the two members **38, 40** may also be reversed in some embodiments. As the spreader member **40** slides relative to the expansion member **38**, the expansion member **38** either moves outward or inward. Specifically, the expansion member **38** is moved outward from a nonbiased position by an extending movement E of the spreader member and held in the outward position by the spreader member. The expansion member **38**, therefore, springs back inward as the spreader member **40** retreats during its retracting movement. When the expansion member **38** is moved outward, a normal force N between the expansion member **38** and the inner wall **42** of the opening **24** increases. The increasing normal force N results in an increasing frictional force F that will tend to oppose rotational movement of the locking cap **20** relative to the opening **24** as well as tending to opposing sliding movement of the locking cap **20**. Thus, the locking cap **20** may be locked into place within the opening **24** and the locking cap **20** may not be easily removed therefrom without first reducing the normal force N.

[**0033**] As will be appreciated, a similar structure may also be configured for use on the exterior of an pipe or the like which might allow a cap to be placed over the outside of the pipe or the like. Additionally, as will be described below in greater detail, the expansion member **38** of the illustrated embodiment is substantially coextensive with a circumference of the inner surface of the opening **24** in which the locking cap **20** is positioned; however, it is anticipated that single or multiple fingers may also perform the locking function through individual or discreet contact positions.

[**0034**] With reference again to **FIGS. 3A and 4**, the expansion member **38** of the illustrated locking cap **20** will now be described in detail. As will be recognized by those of skill in the art, the expansion member **38** may have many shapes and configurations. For instance, the expansion member **38** may be conical, rectangular, spherical, hemispherical or tubular in nature. However, in the presently preferred embodiment, the expansion member **38** is cylindrical. The cylindrical configuration advantageously increases the contact surface area between the expansion member **38** and the inner surface **42** of the opening **24** as compared to most other configurations. Specifically, as the expansion member **38** is displaced outward into contact with the inner surface **42** of the opening **24**, the contact surface area is increased due to the arcuate exterior surface defined by the cylindrical configuration.

[**0035**] The expansion member **38** may be formed of any suitable material utilizing any number of well known machining techniques, including but not limited to milling, drilling, turning and the like. Additionally, the expansion member **38** may be forged, molded, or cast depending upon the characteristics of the material selected for use in the expansion member **38**. The selection of the material used desirably accounts for the material properties and attempts to reduce galvanic corrosion. As will be recognized, the material selected for use may be a high strength polymer or metal, for instance. It is understood that galvanic corrosion in metal-on-metal contacts may be reduced by the use of a protective metal coating, such as zinc, tin, lead, nickel, or copper, by producing a coating of oxide, phosphate, or a similar coating on any iron and/or steel surfaces, or by utilizing protective paints to render the metal surface passive. In the presently preferred embodiment, the expansion member **38** is made from a slug of brass because it will form a plug for a brass standpipe **22**. The selection of this material advantageously avoids the harmful composite side-by-side relationship of two differing metals that often may result in galvanic corrosion.

[**0036**] With reference again to **FIGS. 3A and 4**, the expansion member **38** generally has a front surface **44**, a rear surface **46** (see **FIG. 4**), and a side surface **48** extending substantially longitudinally between the front surface **44** and the rear surface **46**. The expansion member **38** may be sized and configured for easy insertion into the opening **24** that is to be capped. In one embodiment, the expansion member **38** has a major outside diameter D that is advantageously smaller than the inner diameter of the opening **24** into which it is inserted. This allows the expansion member **38** to be slid into place rather than requiring the expansion member **38** to be threaded into place. For applications such as fire standpipes, the major outside diameter D may range from about 1 inch to about 5 inches. Preferably, the major outside diameter D ranges from about 1.375 inches to about 3.25 inches. Even more preferably, the outside diameter is expandable from between about 2.90 inches to about 3.25 inches when the present locking cap is sized and configured for an ordinary fire standpipe. One of ordinary skill in the art will readily recognize that the ranges may be varied depending upon the application and also depending on the degree of initial interaction desired between the locking cap and the opening.

[0037] The side surface **48** may be stepped or straight. In the illustrated embodiment, the side surface **48** is stepped and has a larger-diameter portion **50** which extends rearward from the front surface **44** between about 0.5 inches and about 1.0 inches. As introduced above, the larger-diameter portion **50** preferably has external threads **34** that mate with threads **52** of the opening **24**. As is known, the threads **34**, **52** may be of any suitable size and configuration. For instance, when used with fire department standpipes, the threads would be configured according to the local fire department's specifications. Additionally, as is known, at least three threaded turns are desired; however, any number of threads **34** acceptable for the specific application may be provided on the locking cap **20**. Moreover, dependent upon the application, more than one set of threads may also be used. For instance, two half turn threads may provide about the same holding force as a single thread but will require only a half turn to remove the locking cap.

[0038] With continued reference to **FIG. 3**A, the larger-diameter portion **50** is forward of a stepped down portion **54** that is preferably formed between the larger-diameter portion **50** and the rear surface **46**. The stepped down portion **54** allows the overall thickness of the expansion member **38**, or the plug portion **30**, to be increased while reducing the likelihood that the locking cap **20** may damage the fitting into which it is inserted. Specifically, a hose coupling, with which the present cap has specific utility, generally has a union nut with an inner bearing race (not shown) that may be damaged if the locking cap **20** exerts sufficient pressure against an inner lip (not shown) of the union nut which is associated with the bearing race. Accordingly, the larger portion **50** and the stepped down portion **54** are desirably dimensioned to allow the locking cap **20** to be fully tightened into position without harming the hose coupling. In one embodiment, the overall length (i.e., the combined length of the larger portion and the stepped down portion) is between about 1.0 inch and about 1.5 inches. More preferably, the overall length is about 1.375 inches.

[0039] Significantly, the threads **34** are preferably matched to the internal threads **52** of the opening **24**. Such a configuration reinforces the internal threads **52** of the opening **24** such that the threads **52** are less likely to be deformed or damaged when the locking cap **20** is locked into position. Additionally, when the illustrated locking cap **20** is locked into place, the opening **24** is reinforced and internally supported by the material forming the locking cap **20** such that the opening **24** is unlikely to be deformed if dealt blows by a pipe wrench or the like. Moreover, the intermeshed threads **34**, **52** maintain the threads **34** of the opening **24** substantially clear once the locking cap **20** is removed such that the opening is maintained in better working condition (i.e., less corrosion and debris as compared to standard or missing caps or covers).

[0040] As illustrated in **FIG. 3**B, the expansion member **38** has a longitudinally extending interstitial slot **56** extending partially across its diameter. The interstitial slot **56** may be arranged to extend through a longitudinal axis of the expansion member **38** or may be offset to either side.

[0041] The end of the interstitial slot **56** terminating within the expansion member **38** is joined to an aperture **58** which also extends through the expansion member **38** in a longitudinal direction. The aperture **58** is considered a relief aperture because it allows the material of the expansion member **38** to flex without exceeding its elastic limit. For instance, the expansion member **38** preferably provides hard sides which are hinged outward in an elastic deformation of the expansion member and are wedged against the sides of the pipe into which the locking cap is inserted. Due to the elastic springing action of the plug portion's expansion member and its hard side surfaces, the expanded plug portion provides an advantageously non-deforming locking element. Accordingly, the amount of material removed by the relief aperture **58** or the overall size of the relief aperture **58** is partially dependent upon the modulus of the material selected for the expansion member **38**. Additionally, the relief aperture **58** is advantageously arcuate in shape (i.e., similar to a slot) to better distribute bending stresses throughout the material of the expansion member **38**. The illustrated relief aperture or opening **58** comprises three holes having overlapping edges; however, a variety of other configurations (i.e., smooth milled slot, hole, etc.) may also be used.

[0042] As best illustrated in **FIG. 4**, the expansion member **38** also comprises a pair of holes **60**, **62**. The first hole **60** is used with a threaded fastener **64** to connect the expansion member **38** to the faceplate **32**. As will be recognized by those of skill in the art, the first hole **60** may be arranged substantially anywhere within the expansion member **38** which allows the threaded fastener **64** to pass therethrough and fasten the face plate **32** to the expansion member **38**. The hole **60** may then be filled with epoxy to seal the forward portion of the hole for protection from the elements and tampering. Moreover, if the faceplate **32** is attached to the expansion member **38** is another manner (i.e. welded in a manner that still allows the expansion member **38** to flex) the first hole **60** may be removed.

[0043] The second hole **62**, however, provides a channel **66** in which the spreader member **40** translates. The second hole **62** is positioned along the interstitial slot **56**. As will be recognized by those of skill in the art, the closer to the side surface **48** (i.e., the circumference) that the second hole **62** is positioned along the interstitial slot **56**, the less leverage is required to spread the expansion member **38**. However, as will also be recognized, a sufficient thickness of material should remain between the second hole **62** and the side surface **48** to reduce the likelihood of failure through the side surface **48**. The maximum diameter of the second hole **62** desirably ranges from about 0.5 inch to about 0.75 inch.

[0044] The second hole **62**, because it provides a spreader member channel **66**, may have a tapered surface **68** extending in either longitudinal direction. It should be appreciated, however, that a tapered spreader member **40** could travel into a non-tapered channel and achieve a similar effect or vice versa. In other words, the wide end of the second hole **62** can be arranged at either the front surface **44** or the rear surface **46** of the expansion member **38**. However, the arrangement of the components preferably results in a loosening counterclockwise rotation of the actuator bolt **28** and a tightening clockwise rotation of the actuator bolt **28** such that the locking cap substantially conforms to standardized fastening arrangements. In the illustrated embodiment, the channel **66** tapers from a rear diameter of about 0.75 inch to a forward diameter of about 0.40 inch. These dimensions are illustrative only and may vary depending upon the application and materials selected. The taper is

desirably configured to allow the necessary outward expansion with the amount of travel provided for the spreader member **40**. In other words, the taper desirably allows the necessary expansion of the expansion member **38** when the spreader member **40** passes from a first position to a second position within the channel **66**.

[**0045**] With continued reference now to **FIG. 3, a** spreader member **40** and an actuator mechanism **70** will now be described in detail. As described above, the spreader member **40** translates within the channel **66** under the control of the actuator mechanism **70** to effect expansion and contraction of the expansion member **38**. This controlled translation affords positive control of the expansion and contraction of the expansion member **38**. Accordingly, preferred materials for the spreader member **40** generally include such materials which will not substantially gall or corrode within the channel **66**. Accordingly, the presently preferred material for the spreader member **40** is a hard, polished metal. For instance, the material may be a case hardened steel having a cadmium coating to reduce galvanic corrosion. Specifically, the steel may be case hardened by carborizing and then may be baked with a Cad II type coating.

[**0046**] The spreader member **40** advantageously has a tapered or sloping surface **72**, or a flat surface that cooperates with the tapered or sloping surface **68** of the channel **66**. As described above, the interacting surfaces **68, 72** result in the expansion or contraction of the expansion member **38** about the interstitial slot **56** when the bolt **28** is rotated. The presently preferred spreader member **40** is frusta conical (i.e., the base portion of a cone). As such, the frusta-conical spreader member **40** may be drawn through the tapered spreader member channel **66** defined by the second hole **62** to open the expansion member **38**. As explained above, the inclination angles of both the second hole **62** and the spreader member **40** are partially dependent upon the amount of expansion desired and the length of the second hole **62** (which may be, in turn, dependent upon the overall length of the plug portion **30** or expansion member **38**). In the illustrated embodiment, the inclination angle of the spreader member **40** is about 5 degrees from perpendicular to its base.

[**0047**] The illustrated spreader member **40** is moved along the spreader member channel **66** by the actuator mechanism **70**. The actuator mechanism **70** may take a number of forms; however, the illustrated actuator mechanism **70** acts as a worm and follower actuator. Specifically, the spreader member **40** has a longitudinally extending threaded through hole **74** and a substantially axially extending orienting pin **76**. The illustrated orienting pin **76** extends substantially normal to the longitudinal axis of the locking cap **20** and is sized to allow free travel within the interstitial slot **56** while also limiting the free rotation of the spreader member **40** relative to the expansion member **38**. The orienting pin **76** may be any suitable member such as, for instance but without limitation, a roll-pin, a dowel pin or a raised surface or flange. Additionally, the material selection is dependent upon strength and corrosion properties as discussed above. In the illustrated embodiment, the orienting pin is a 0.125 inch diameter stainless steel dowel that is press fit into the spreader member **40** about 0.17 inch deep. Other mounting arrangements, of course, are well within the knowledge of those having ordinary skill in the relevant art.

[**0048**] The through hole **74** of the spreader member **40** is sized to accommodate the actuator bolt **28** which has sufficient strength to reduce the likelihood of failure during spreader member motion. The bolt size may range from about #10 to about 0.5 inch, but is about 0.375 inch in the presently preferred embodiment. Additionally, the pitch of the threads may be between about 32 threads per inch and about 13 threads per inch, but the presently preferred pitch is about 16 threads per inch. At this pitch, when combined with the preferred inclination angles, the locking cap **20** may be locked into an opening **24** with about three turns of the actuator bolt **28**. It is also anticipated that the locking cap **20** may be locked into an opening with more or less than three turns of the actuator bolt **28**.

[**0049**] With continued reference to **FIG. 3A, a** head portion **78** of the bolt **28** is preferably received in a recess **80** in the face plate **32** while a shank **82** of the bolt **28** preferably extends through the face plate **32**, the second hole **62** of the expansion member **38**, the threaded through hole **74** of the spreader member **40** and a washer/nut combination **84**. Desirably, the washer/nut combination **84** includes a nylon washer **85** to reduce friction between the combination of a stainless steel washer **87** and a lock nut **89** and the back surface **46** of the expansion member **38**. Advantageously, the lock nut **89** is configured to intentionally cross-thread onto the bolt **28** and, thereby, become permanently attached to the bolt **28**. As will be recognized by those of ordinary skill in the art, an adhesive coating may also be used to reduce the likelihood of any other type of nut **89** working free of the actuator bolt **28**.

[**0050**] As introduced above, the expansion member **38** is preferably attached to the faceplate **32**. The faceplate **32** may be manufactured from a variety of materials. For instance, the faceplate **32** may be manufactured from hardened polymers, plastics, and a variety of metals. Preferably, the faceplate **32** is manufactured from anodized aluminum, brass, chrome-plated brass or case-hardened steel coated with cadmium. Even more preferably, the faceplate **32** is manufactured from anodized aluminum, brass or a chrome plated brass. In this manner, a variety of surface finishes may be provided to coordinate with color and accent themes of a highly visible public region of a building.

[**0051**] With reference now to **FIG. 4**, the faceplate **32**, in addition to being decorative and capable of receiving various finishes and colors, protects the inner workings of the locking cap **20**. The faceplate **32** generally has a front surface **86** and a back surface **88**. In some configurations, the faceplate **32** may have an exposed side surface **90** when installed. For instance, the face plate **32** may take on any of a variety of shapes, including, but not limited to, conical, cylindrical, spherical, hemispherical, or any of a number of more complex configurations. In the illustrated embodiment, the faceplate **32** is substantially cylindrical with a chamfered forward edge **92**. Importantly, the cylindrical side surface **90** has a short length such that standard tools (i.e., channel locks) may not obtain a sufficient grip on the face plate **32** to turn the locking cap **20** when locked into place. The chamfered edge **92** of the presently preferred face plate **32** allows the exposed thickness of the face plate **32** to be greater than the cylindrical portion described above. Generally, the exposed thickness varies from about 0.30 inch to about 0.60 inch while in a preferred embodiment, the

exposed thickness is about 0.50 inch with only about 0.20 inch of that thickness having a cylindrical sidewall.

[0052] The faceplate **32** also has at least one pin **94** that extends forward from the front surface **86** of the faceplate **32**. The pin or pins **94** allow gloved personnel to effectively grip the locking cap **20** to remove the locking cap **20** in all weather conditions and during extreme heat such as that encountered due fires. Additionally, where the locking cap **20** has been painted over or corroded, the pins **94** allow a specially designed key handle **96** (see **FIG. 3**), disclosed in more detail below, to engage the locking cap **20** for breaking the paint or corrosion seal. Specifically, the front surface **86** of the faceplate **32** may have a triangulated pattern of three or more pins **94** to form a gripping surface. More preferably, two pins **94** may span a portion of the front surface **86** diameter.

[0053] Advantageously, the pins **94** are also sized and configured to reduce tampering. Specifically, the pins **94** may be intentionally low profile to reduce the likelihood that a standard breaker bar may be placed between them to create leverage for turning the locking cap **20**. The pins **94** may also have a tapered tip **98** such that tampering attempts are further thwarted. In the illustrated embodiment, the pins **94** have cylindrical bodies which are press-fit from the back **88** surface of the face plate **32** and which extend between about 0.20 inch to about 0.30 inch above the front surface **86** of the face plate **32**. Preferably, the cylindrical portions (i.e., that below the tapered tips **98**) extend about 0.16 inch above the front surface **86** of the faceplate **32**. The tapered regions **98** of the illustrated pins **94** then extend an additional length which is preferably between about 0.08 inch and about 0.15 inch, more preferably about 0.10 inch.

[0054] In one embodiment, a chain stay (not shown) may be attached to the front surface **86** of the faceplate **32** using an acorn nut (not shown) on the threaded fastener **64** that extends through the first hole **60**. The chain stay allows the locking cap **20** to be chained to the standpipe **22** or other location such that it is not easily misplaced when removed. As will be recognized by those of skill in the art, the chain stay or chain may also be attached in a variety of other well-known manners.

[0055] As described above and illustrated in **FIG. 5**, the locking cap **20** is desirably used with the key **26**. With reference now to **FIGS. 5 and 6**, the key **26** will be described in detail. The key **26** has a key head **100** that extends from the handle portion **96**. The handle portion **96** may have various configurations. For instance, the handle portion **96** may be cylindrical, rectangular in cross-section, or any other suitable configuration. The handle portion **96** preferably is shaped in a "T" having a narrow arm portion **102** extending from the key head **100** and terminating in a cross-member portion **104**. Additionally, the handle portion **96** is preferably formed from 10-gauge cadmium plated steel. The material selected need only be capable of withstanding sufficient bending moments to allow the tightening of the locking mechanism **36**. However, the material may be coated for aesthetic reasons or otherwise treated to achieve the desired material characteristics.

[0056] The narrow arm portion **102** preferably has a width that allows the arm to bend when the locking cap **20** is sufficiently tightened into position to reduce the likelihood of over-tightening the locking mechanism **36**. For instance, when the key **26** is over-torqued, the narrow arm portion **102** may begin to assume a permanently set spiral bend configuration. By deforming in such a manner, the key **26** provides a mechanism for protecting the locking cap and pipe as well as indicates to the user that the bolt is being over-torqued. For instance, the key may withstand torques between about 40 inch-pounds and about 140 inch-pounds. Preferably, the key may withstand between about 90 inch-pounds and about 125 inch-pounds. Even more preferably, the key may withstand about 100 inch-pounds. The illustrated narrow arm portion **102** has a width of between about 0.75 inch and about 1.0 inch. Preferably, the width is about 0.875 inch.

[0057] The cross-member portion **104** preferably accommodates the pins **94** of the faceplate **32**. Specifically, the cross-member portion **104** may have sufficient width to allow the cross member portion **104** to span and receive the pins **94** in a set of complementary holes **106**. In this manner, the cross-member portion **104** and the balance of the key **26** may act as a breaker if the locking cap **20** cannot be removed by hand. Thus, the key **26** both unlocks the locking cap **20** and allows emergency removal if the locking cap **20** is stuck or jammed in position within the opening **24**. Accordingly, the number of tools necessary to remove the locking cap **20** under most operating conditions is reduced to one.

[0058] A snapping ring (not shown) may also be attached to the key **26** in any suitable manner. The snapping ring attaching flange **108** is preferably arranged along one side of the narrow arm portion **102** and is more preferably arranged such that the lengths of the key **26** extending on either side of the attachment point are balanced for weight. The snapping ring attaching flange **108** accommodates a snapping ring that allows emergency response teams or service technicians to snap the key **26** onto turn-out gear so the key **26** is less likely to be lost following use.

[0059] The key head **100** is sized and configured to engage with the actuator bolt head **78** that forms a part of the actuator mechanism **70**. Because the actuator bolt **28** is turned by its head **78**, the complementary key head **78** acts as a driver by enabling one to engage the actuator bolt head **78** with the key head **100** (i.e., similar to a lug and socket) and to then turn the actuator bolt **28** with the key **26**. As described in detail above, turning the actuator bolt **28** enables one to selectively lock and unlock the locking cap **20**. It is understood that a threaded fastener such as the actuator bolt **28** may also be inserted from the other end and, accordingly, the key head **100** would have to interact with a different member (i.e., a nut) to provide the necessary engagement.

[0060] With reference to **FIGS. 7 and 8**, the key head **100** and the bolt head **78** may be configured with any of a number of engaging structures **110, 112**. As is known, one of the two heads may have a male portion **100** and the other head may have a female portion **112**, or the key head **100** and the bolt head **78** may have an interlocking hermaphroditic configuration that allows the two to engage without requiring singularly male or female members (i.e., opposing shoulders which extend across half of each). In the illustrated embodiment, the key head **100** has a male pattern **110** while the bolt head **78** has a complementary female pattern **112**. Of course, these patterns may also be reversed.

[0061] The general pattern used may be any suitable pattern, including an arrangement of various pins and cor-

responding holes. For instance, a three, four, five or eight-sided pattern may be employed. Because the locking cap **20** is desirably rapidly removed, sometimes by anxious emergency personnel, the pattern is desirably repeating such that the key head **100** will easily engage the bolt head **78** in a variety of orientations. Moreover, a locator pin **114** may be centrally arranged to aid in proper location of the key head on the bolt head. Thus, a recess **116** the key head will seat upon the locator pin **114** for rotation until the patterns **110, 112** drop into engagement. As will be appreciated, the locator pin **114** may also be provided on the key **26** and cooperate with a recess in the bolt head **78**.

[**0062**] Due to the unsecured service environments in which the locking cap **20** is likely to be used, a pattern having an odd number of sides is presently preferred. Such patterns appear more difficult to fabricate and reduce the likelihood of tampering by temporary tooling. Thus, the likelihood of unauthorized removal of the locking cap **20** may be decreased by utilizing an odd number of sides. More preferably, the pattern will use a number of non-straight lines. Such lines make the pattern even more difficult to duplicate ad hoc or to otherwise counterfeit. In the illustrated embodiment, one of many seven sided cloverleaf designs is implemented; however, as will be recognized, any of a number of other shapes and configurations is also available. The illustrated cloverleaf features a pattern which repeats about every 50° and, therefore, the key **26** may only need to turnabout 25° in either direction relative to the bolt **28** before engagement occurs between the two members **78, 100**.

[**0063**] A bolt head pattern groove **118** is preferably inset within the actuator bolt head **78** to a depth sufficient to allow the key **26** to generate sufficient torque to turn the actuator bolt **28** even if the groove **118** is more than half full of ice, debris or the like. More preferably, the bolt head pattern groove **118** is between about 0.05 inch and about 0.06 inch deep. As will be recognized by those of skill in the art, the bolt head pattern groove **118** may also have a variable depth that is not consistent throughout the pattern groove. For instance, the pattern groove **118** may have alternative peaks and valleys that allow for increased engagement between the key **26** and the actuator bolt **28**.

[**0064**] As will be recognized, the head pattern groove **118** also has a groove width. Preferably, the groove width is sufficient to allow a cleaning stylus or pick to travel therein for cleaning and maintenance. Thus, if the pattern groove **118** becomes filled with ice, debris or the like, the pattern groove **118** can be sufficiently cleaned to allow the key **26** to get a bite on the bolt head **78**. Preferably, the groove width is between about 0.04 inch and about 0.08 inch. More preferably, the groove width is about 0.055 inch.

[**0065**] With reference to **FIG. 7**, the key head pattern ridge **120** is advantageously sized and configured to complement the bolt head pattern groove **118**. Moreover, the ridge **120** may be press forged from a tool steel blank or otherwise formed by methods well known to those of skill in the art. It is understood that the actual ridge **120** may be formed on an insert that is connected in any suitable manner to the balance of the key **26**. Where multiple locking caps are likely to be used, the key head **78** may be formed of a harder material such that the key head pattern **120** is less likely to deform than the bolt head pattern **118**. However, in instances where a single locking cap is likely to be found, the bolt head pattern **118** may be formed of a harder material such that the locking mechanism **36** of the sole locking cap is not damaged and the associated single opening **24** rendered inoperable until the locking cap is damaged or destroyed for removal.

[**0066**] With reference to **FIGS. 6 and 8**, the illustrated key head ridge **120** is protected by a shoulder wall **122**. The shoulder wall **120** is preferably sized to encase the tip of the key **26**. Thus, if the key **26** is dropped or otherwise impacted, the key head pattern ridge **120** is unlikely to be harmed. The recess **80** within the face plate **32** is preferably sized to accommodate the shoulder wall **122** and may be configured to use the shoulder wall **122** as a guide to direct the key head **78** into alignment with the locking cap locking mechanism **36 (FIG. 2)**. As will be recognized by those of skill in the art, the shoulder wall height relative to the ridge height may be varied as desired. Indeed, the shoulder wall may also be eliminated in some locking cap and key configurations.

[**0067**] While one presently preferred embodiment having features, aspects and advantages in accordance with the present invention has been depicted and described in detail, a variety of other locking cap configurations are also envisioned. For instance, an externally threaded pipe opening **24** may receive a locking cap with internal threads. In such a configuration, an expansion member **38** may work from within the pipe opening **24** to pinch the pipe wall between an external cap lip and the expansion member **38**. Moreover, a locking finger cam may also be provided which is rotated through use of the actuator bolt **28**. For instance, as the actuator bolt **28** turns, the locking finger cam may rotate and effectively expand outward as the cam surface undulates about the axis of rotation. Such outward expansion may allow the locking finger cam to engage an inner pipe surface, an inner thread, or a projection specially designed for such an interconnection.

[**0068**] As will be apparent to those of ordinary skill in the art, various other configurations of locking caps are possible which use the broad concept of a locking cap which is secured to a pipe end using a keyed lock actuator member. Accordingly, although the present invention has been described in terms of a certain preferred embodiment, other embodiments apparent to those of ordinary skill in the art, including embodiments that do not provide all of the benefits, aspects and features set forth herein, are also considered to be within the scope of the present invention. Thus, the scope of the present invention is intended to be defined only by the claims that follow.

What is claimed is:

1. A locking cap for a pipe end, the locking cap comprising a face plate and a plug portion, the face plate having a front surface and a rear surface, the plug portion having a front surface, a rear surface and a side surface, a slot extending longitudinally between the front surface and the rear surface and radially between the side surface and a relief opening defined within the plug portion, a channel defined through the plug portion along the slot, the plug portion connected to the face plate with the rear surface of the face plate arranged to substantially face the front surface of the plug portion, the plug portion sized and configured to be received by the pipe end with the side surface of the plug portion having a surface area generally coextensive with an inner contacted surface of the pipe end, the channel receiv-

ing a longitudinally translatable spreader member wherein at least one surface of the spreader member or the channel is tapered such that the spreader member and the channel cooperate to expand and retract the plug portion.

2. The locking cap of claim 1 further comprising an actuator mechanism, the actuator mechanism having an actuator shaft which extends through the channel and is engaged with the spreader member such that as the actuator shaft rotates within the channel the spreader member translates within the channel.

3. The locking cap of claim 2, wherein the actuator shaft has an actuator head portion, the actuator head portion being selectively engageable with a key head portion such that the key head portion selectively causes the actuator to rotate.

4. The locking cap of claim 3, wherein the actuator head portion has a female pattern and the key head portion has a male pattern that is complementary to the female pattern.

5. The locking cap of claim 4, wherein the female pattern is a cloverleaf consisting of seven apexes and eight wavy grooves interconnecting the seven apexes.

6. The locking cap of claim 4, wherein the female pattern comprises at least five apexes.

7. The locking cap of claim 1, wherein the plug portion is formed from brass.

8. A locking cap for an opening, the locking cap comprising a cap body, the cap body having an elastic expansion member and a spreader member, the elastic expansion member and the spreader member having a sloping interface such that relative axial movement of the expansion member and the spreader member result in radial displacement of at least a portion of the expansion member when under a biasing force from the spreader member such that the expansion member is urged into frictional interlock with an inner surface of the opening.

9. The locking cap for a pipe end of claim 8 further comprising an actuator mechanism connected to either the expansion member or the spreader member.

10. The locking cap for a pipe end of claim 8 further comprising an actuator mechanism connected to the spreader member.

11. The locking cap for a pipe end of claim 10, wherein the actuator mechanism comprises a worm and follower actuator with the spreader member forming a follower portion.

12. The locking cap for a pipe end of claim 10, wherein the actuator mechanism comprises a selectively intermeshing actuator shaft and key arrangement.

13. The locking cap for a pipe end of claim 12 wherein the selectively intermeshing actuator shaft and key arrangement comprises a substantially male pattern arranged on one of the actuator shaft or the key and a substantially female pattern arranged on the other of the actuator shaft or the key.

14. The locking cap for a pipe end of claim 10 further comprising an externally threaded surface extending substantially entirely around the expansion member configured to engage with an internally threaded surface of the pipe end.

15. A locking cap for a pipe end comprising a face plate, the face plate having a front surface and at least two pins projecting from the front surface, the face plate having a back surface and being connected to a plug portion such that the back surface of the face plate is proximate a surface of the plug portion, at least a portion of the plug portion being capable of selective expansion and contraction to create a frictional interlock between the locking cap and the pipe end.

16. The locking cap for a pipe end of claim 15 wherein the pins are selectively engageable by a key element for effecting leveraged rotation of the locking cap relative to the pipe end.

17. The locking cap for a pipe end of claim 16, wherein two pins each have center lines and the centerlines are positioned a first distance apart, and wherein the key element further comprises a handle having at least two holes which are the first distance apart on center.

18. A lockable closure for an open end of a tubular element, the closure comprising a radially expanding member and an actuator shaft, the actuator shaft having a first end and a second end, the first end of the actuator shaft having a keyed configuration, the second end of the shaft extending through the closure into the tubular element, the actuator shaft being rotatable relative to the closure and being connected to the radially expanding member such that rotation of the actuator shaft in one direction effects generally outward movement of the radially expanding member and rotation of the actuator shaft in the other direction effects generally inward movement of the radially expanding member.

19. The lockable closure of claim 18, wherein the keyed configuration comprises at least seven sides and corresponds to a keyed configuration of an associated key.

20. The lockable closure of claim 19, wherein the lockable closure is engaged within open end of the tubular element through interlocking threads on a side surface of the lockable closure and within the open end of the tubular element.

21. A locking cap for closing an open end of a pipe that has a threaded inner surface, the locking cap comprising a generally cylindrical body having a threaded outer surface which is configured to engage the threaded inner surface of the pipe, the body being elastically deformable between a first diameter in which the body may be inserted into or removed from the open end, and a second diameter in which the body is frictionally locked within the pipe end, and a spreader assembly, including a bolt, coupled to the body such that rotation of the bolt causes the body to elastically deform between the first and second diameters.

22. The locking cap of claim 21, wherein the first diameter is sized such that the body can be inserted or removed from the open end without rotation.

23. The locking cap of claim 21, wherein about three full rotations of the bolt causes the body to elastically deform between the first and second diameters.

24. A locking cap key for locking and unlocking a locking cap, the key comprising a head and a handle, the head selectively engageable with a related structure on the locking cap and the handle being configured to plastically deform when a level of torque exceeds a predetermined level of torque.

25. The locking cap key of claim 24, wherein the predetermined-level of torque exceeds that required to lock the locking cap in position.

26. The locking cap key of claim 24, wherein the key assumes a permanently set spiral twist as a result of the plastic deformation.

27. The locking cap key of claim 24, wherein the head has a raised pattern disposed on a distal tip of the head.

28. The locking cap key of claim 27, wherein the related structure on the locking cap includes a recessed pattern that is complementary to the raised pattern.

29. The locking cap key of claim 24, wherein the handle includes a hanging ring.

30. The locking cap key of claim 24, wherein the key has a generally T shaped configuration comprising a narrow arm portion and a cross-member, the cross-member having at least one hole disposed therein.

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United States Patent [19]

Hoshino

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[54] **STABILIZED PIPE FASTENER USING AN EXPANDABLE SLEEVE**

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[58] **Field of Search** 403/256, 367, 368, 369, 403/370, 371, 22, 13

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[57] **ABSTRACT**

A pipe fastening device including a split sleeve main tubular body with an upper and a lower internal tapered surface. A lower fixing member at the end of the pipe having a frusto-conically shaped body matching the lower tapered inner surface of the tubular body. An upper movable member also having a frusto-conically shaped body matching the upper inner tapered surface at the top of the tubular body. A bolt from an installation member passes through the fixing member and is fixed in the movable member so that tightening of the bolt draws the movable member toward the fixing member. The tapered surfaces cause the tubular body sleeve to expand for securing the tubular body in the pipe. The fixing member and the movable member have protuberant parts received in the groove of the split sleeve tubular body.

8 Claims, 8 Drawing Sheets

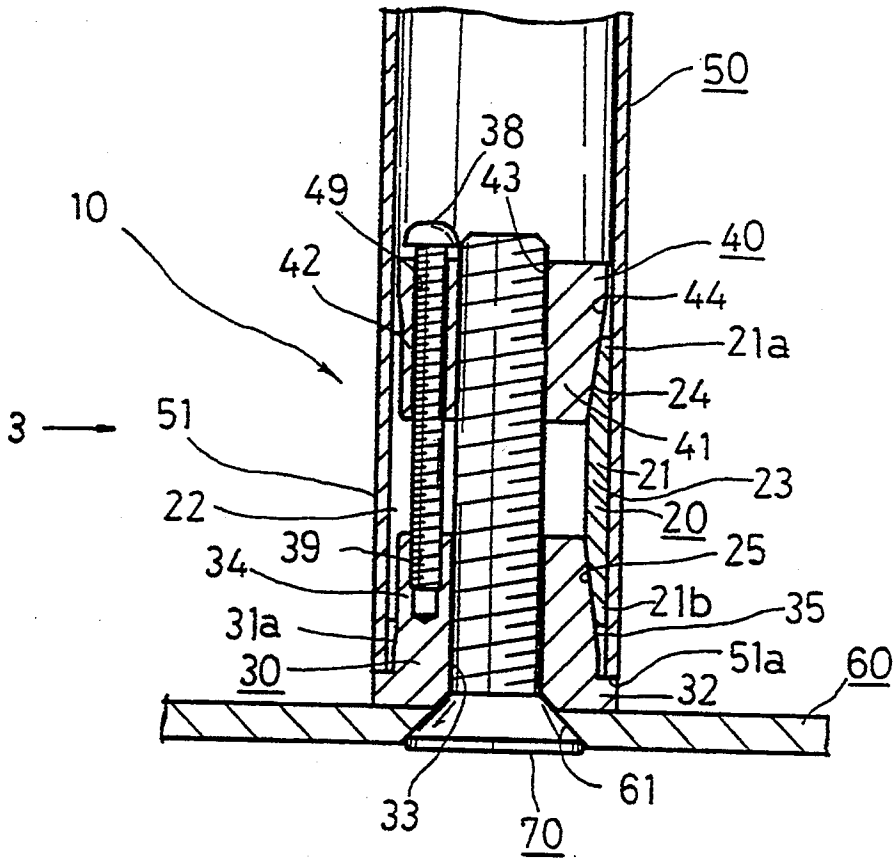

FIG. 1

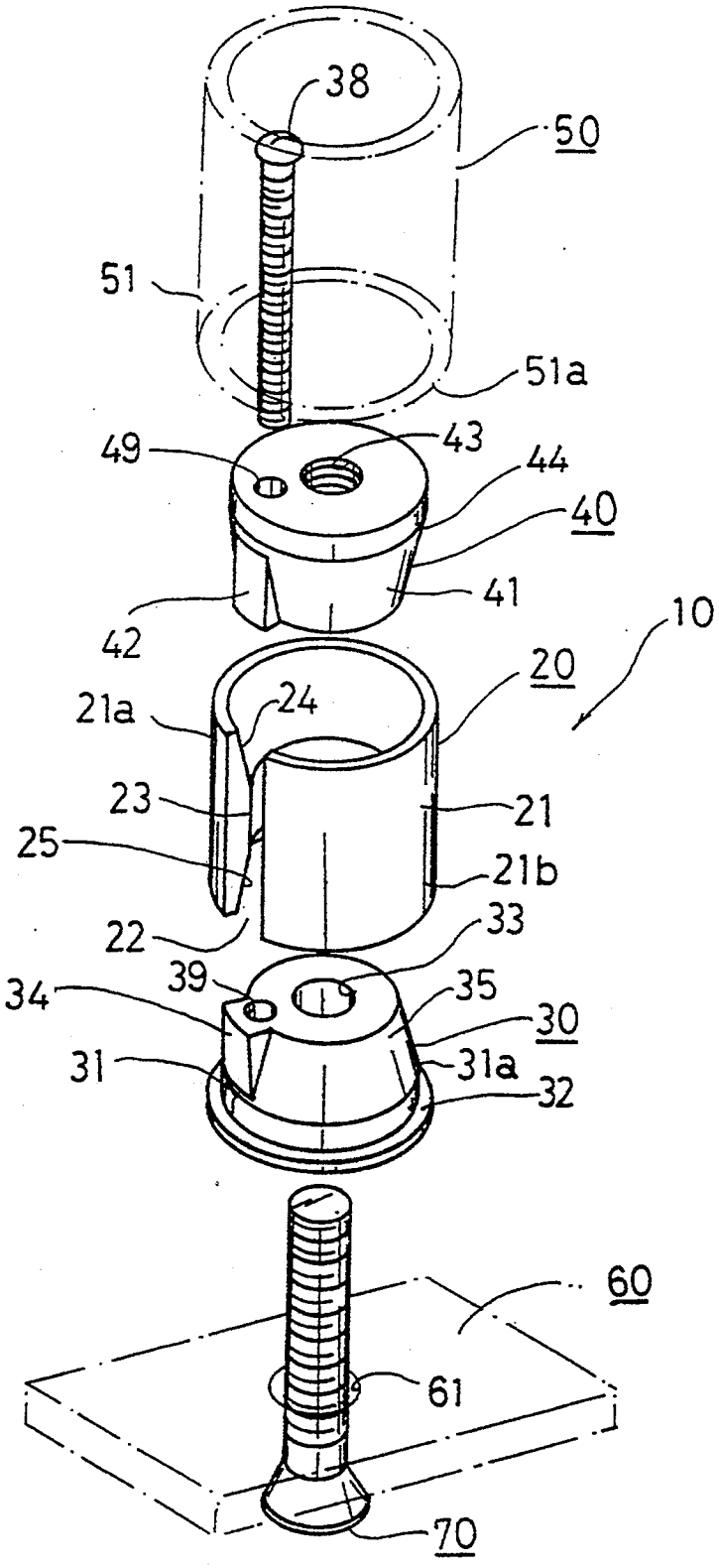
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FIG. 2

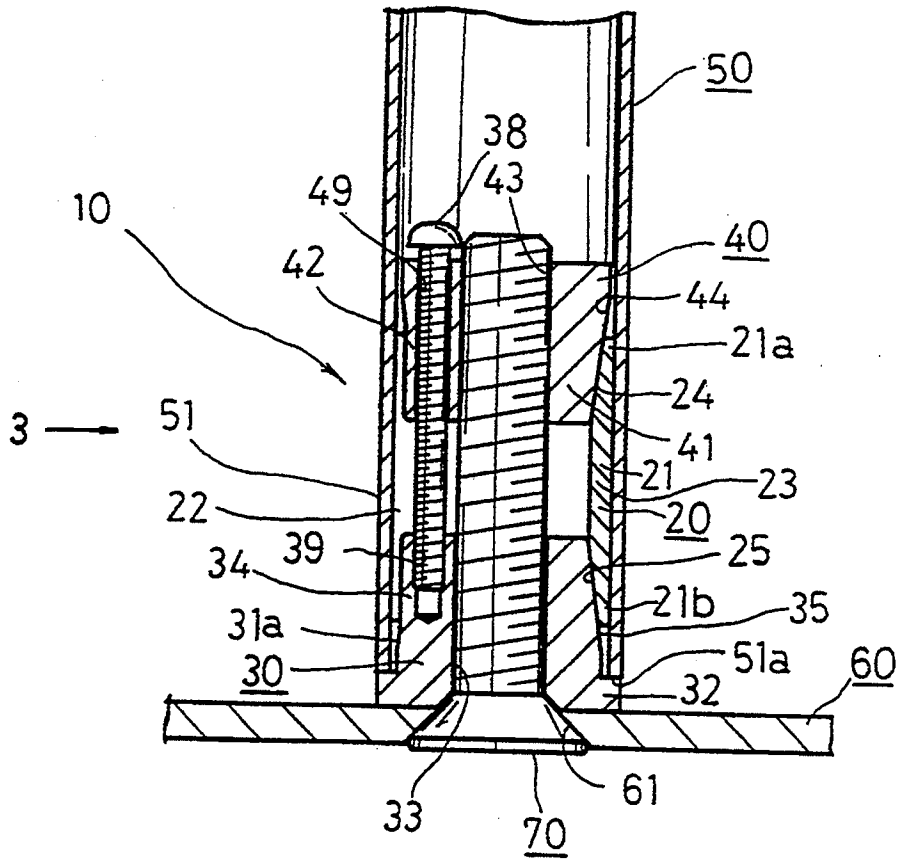
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FIG. 3

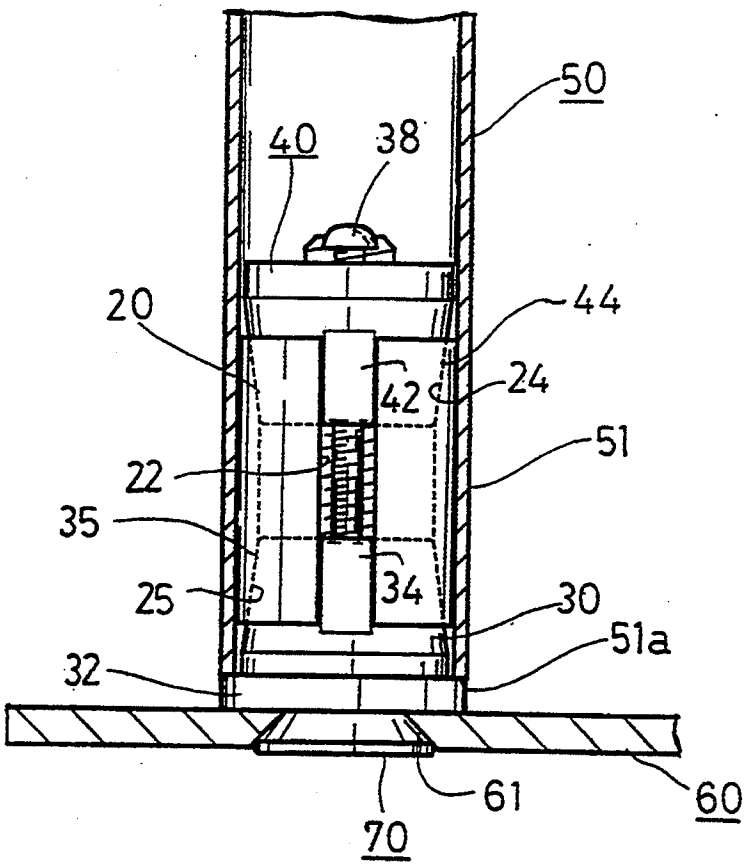


FIG. 4

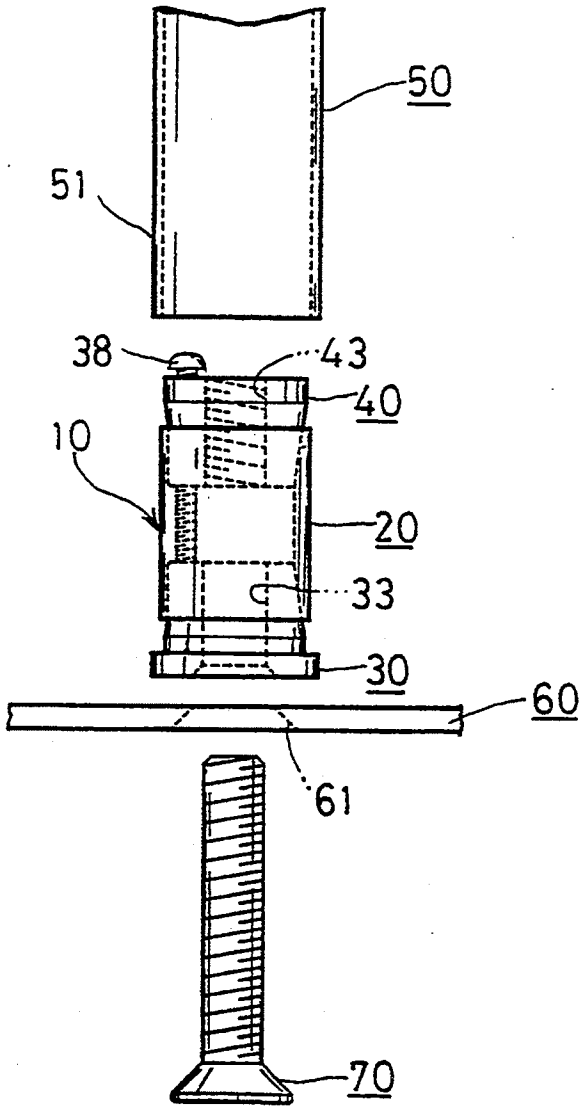


FIG. 5

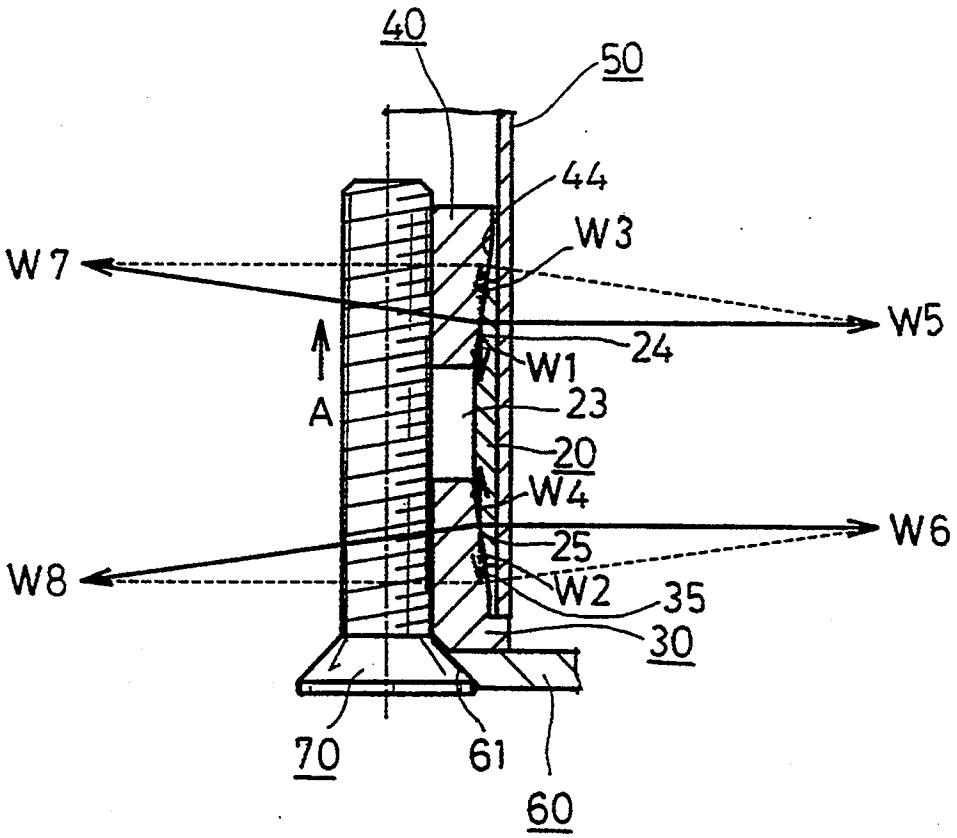


FIG. 6

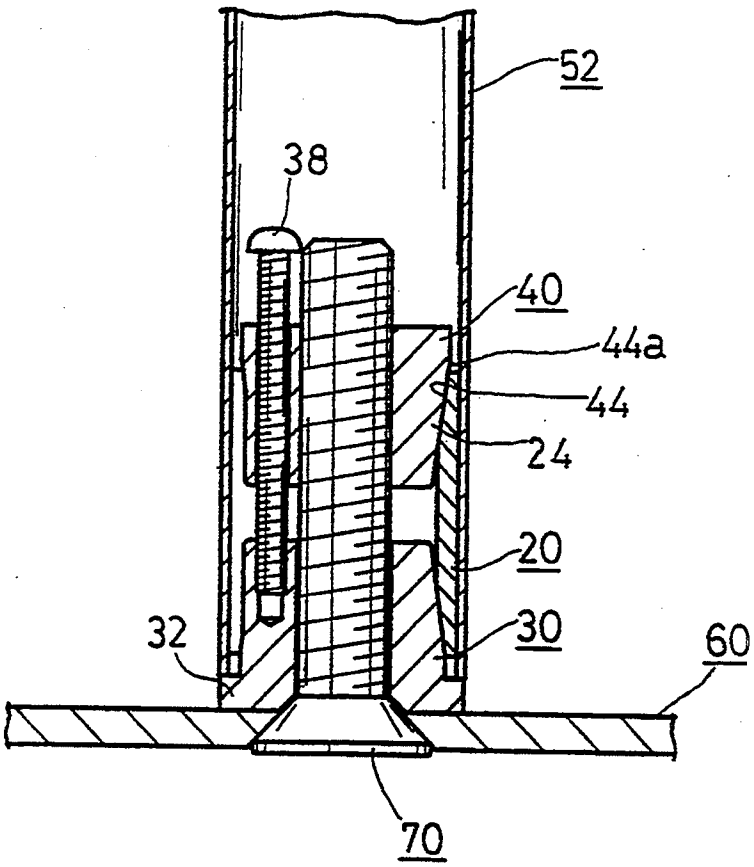


FIG. 7

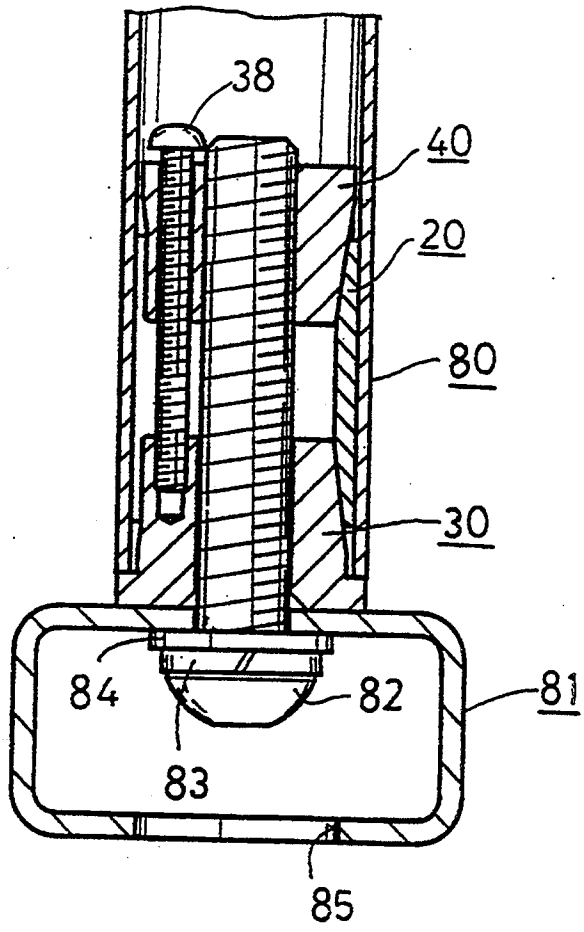
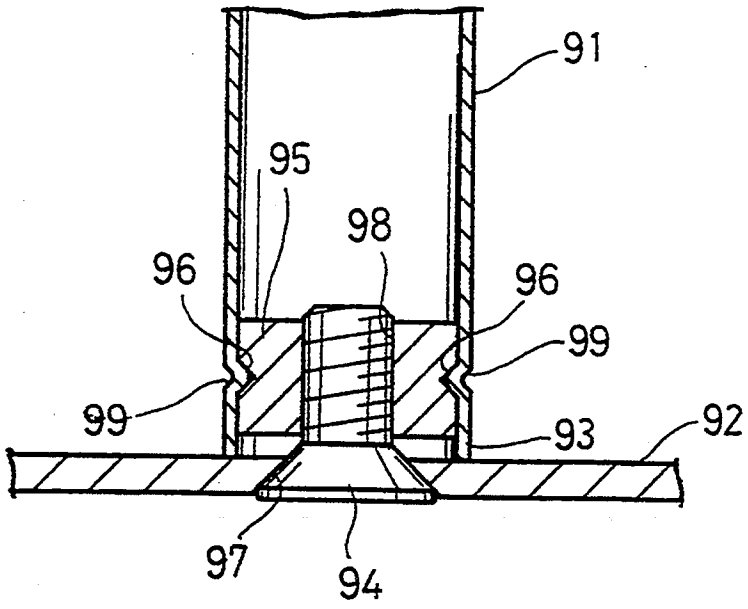


FIG. 8



STABILIZED PIPE FASTENER USING AN EXPANDABLE SLEEVE

BACKGROUND OF THE INVENTION

This invention relates to a fastening structure for fastening a pipe to another element.

FIG. 8 hereof shows a fastening structure for a stand that supports something like a sign or a panel board, to cite an example. In FIG. 8, a board, etc. is installed on a pipe **91**. There is an installation member **92** for the base board, etc.

A connective bush **95**, which is approximately tubular in shape, is inserted into the installation end **93** of the pipe **91**. The connective bush **95** has a circumferential groove **96** around its outer peripheral surface. The bush is fastened to the pipe **91** when the pipe **91** is caulked around the direction of the groove **96** from outside the pipe **91**.

An installation hole **97** for the pipe **91** is formed through the installation member **92**, and the pipe **91** is fastened integrally to the installation member **92** by a tightening screw **94** which is inserted from the reverse side of the installation member **92** and is screwed into the screw hole **98** of the connective bush **95**.

The pipe **91** and the connective bush **95** are fastened at several caulking locations **99**. Its maintenance and fastening are carried out only at several locations on the pipe. This has produced a problem in that a strong holding force is difficult to obtain. This causes a lack of durability against the weight of the board, etc. that is held on the pipe, so that the pipe becomes unsteady.

Further, in such a structure, the inner diameter of the pipe and the outer diameter of the connective bush are the same. This makes it necessary to prepare connective bushes that correspond to the inner diameters of and in conformity with the thicknesses of different pipes in some structures. When there are variations or errors in the inner diameter of the pipe **91**, further, it has been difficult to cope with such errors.

SUMMARY OF THE INVENTION

An object of the invention is to provide a pipe fastening device which is capable of securely fastening a pipe to an installation member with a high holding force. Even when the inner diameters of the pipes to be fastened are different, the pipe fastening device of the invention is capable of securely fastening the pipe to an installation member by using the same device. The invention provides a pipe fastening device having a high holding strength which is capable of firmly fastening the pipe, even for a long period of time, and which is capable of firmly fastening the pipe to an installation member through the same fastening device even where the inner diameters of the pipe to be installed may be different.

The invention relates to a pipe fastening device for fastening to the installation end part of a pipe by a tightening bolt that is inserted into the fastening device from the installation hole of the installation member. There is a main tubular body or sleeve which is inserted into the pipe interior near the installation end of the pipe. The sleeve is split at a groove formed along the length direction of the main tubular body sleeve. The groove both serves an orienting function, described below, and enables the sleeve to be spread for clamping. On the inner surface side of the main tubular body sleeve, there is a split collar toward the middle of the length of the sleeve. Below the collar, there is a lower side tapered surface that tapers thinner, i.e. it has a progressively larger internal diameter, toward the bottom end of the sleeve. Above the collar, there is an upper side tapered surface which also tapers thinner, i.e. it has a progressively larger internal diameter, toward the upper end of the sleeve. A flange below the pipe supports the terminal face of the installation end of the pipe. An outer peripheral tapered surface slides on the upper tapered surface of the split collar as it is formed integrally with the aforesaid flange part.

A fastening member comprises a main body part which is approximately in the shape of a frustum of a cone and which has a through hole for a tightening bolt. The outer peripheral tapered surface of the fastening member is of the pitch angle and diameter of the inner lower tapered surface of the sleeve. These surfaces slide over each other and engage as the fastening member moves into the sleeve from below. A protuberant part at the tapered surface engages the cut groove in the split collar in the sleeve of the fastening member which prevents relative rotation.

A movable member comprises a main body part which is also in the shape of a frustum of a cone with an outer peripheral surface that has a pitch angle and diameter of the inner upper tapered surface of the sleeve. These surfaces slide over each other and engage as the moving member moves into the sleeve from above. There is another protuberant part which engages in the cut groove of the split collar in the sleeve to prevent relative rotation. The movable member has a screw hole for receiving the threaded tightening bolt.

A fastening means, e.g. a tightenable bolt, is operated to draw the movable member in the pipe toward the fastening member at the end of the pipe. This presses the cooperatingly tapered surfaces together and expands the split sleeve to clamp to the interior of the pipe.

Other objects and features of the invention are explained with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view of a pipe fastening device according to the invention.

FIG. **2** is a cross section through the device showing a pipe fastened by the device.

FIG. **3** is a side view of the device.

FIG. **4** is an exploded view thereof with the parts separated.

FIG. **5** is a cross section thereof showing the state in which the forces acting on the device.

FIG. **6** is a cross section thereof showing another state of the device according to the invention.

FIG. **7** is a cross section showing still another example of the invention.

FIG. **8** is cross section of the essential part showing a normal prior art pipe fastening structure.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIGS. **1** through **4**, the pipe fastening device **10** according to the invention comprises a longitudinally split sleeve or main tubular body **20**, a fastening member **30** at the end of the pipe and a movable member **40** inside the pipe at the top of the sleeve. The device is installed at and inside the installation end **51** of a pipe **50**.

The split sleeve **20** comprises a main tubular body **21** which is approximately tubular in shape. It is split in its longitudinal direction by a cut groove **22** formed over the height of the body **21**. The body includes a radially thickened collar **23** whose longitudinally central part is formed thicker, i.e. of smaller inner diameter on the inner surface of the main tubular body **21**. The interior surface of the body **21** includes an inner upper conically tapered surface **24**, which tapers to a gradually larger inner diameter, from the thick collar at the center toward the upper end **21***a* of the body **21** and a lower conically tapered surface **25** which also tapers to a gradually larger inner diameter from the thick collar at the center toward the bottom end **21***b* of the body **21**.

This split tubular body **20** is inserted into the interior of the pipe in the neighborhood of the installation end **51** of the pipe **50**, and that end of the pipe is to then be fastened to the installation member **60**.

The fastening member **30** placed toward the bottom of the main body **21** comprises a body **31** which is approximately in the shape of a frustum of a cone. The body **31** includes an outer peripheral, tapered surface **35** that slidingly contacts the inner lower tapered internal surface **25** of the split tubular body **20**. The outer tapered surface **35** has a pitch angle and diameter generally corresponding to those features on the inner tapered surface **25**.

The body **31** includes a flange **32** which projects outward from the large diameter bottom **31***a* end of the body **31**. The flange **32** underlays and contacts and may be fastened to the installation end **51** of the pipe **50**.

As can be better understood from FIG. **2**, the body **31** has a longitudinal through hole **33** for through passage of a tightening bolt **70**. The hole **33** is formed approximately in the center of the cone frustum. The body **31** includes a protuberant part **34**, which is formed at one location around the outer peripheral tapered surface **35**, for engaging in the groove **22** in the sleeve **20**. This determines the location of the fastening member **30** and facilitates the installation of the stopper **38**, described below, and prevents relative rotation of the bodies **21** and **30**.

The movable member **40** toward the top of the main body **21** is installable inside the pipe **50**. The member **40** comprises a body **41** which is also approximately in the shape of a frustum of a cone. The outer peripheral surface of the main body **41** has a lower outer peripheral tapered surface **44** which slidingly contacts the inner, upper side tapered surface **24** of the split sleeve **20**. The body **41** has a pitch angle and diameter generally corresponding to those features on the inner tapered surface **24**.

The cone shaped members **30** and **40** are oriented to taper narrower toward one another. The movable member **40** includes a screw threaded hole **43** through it that receives the tightening bolt **70** that has extended up from the fastening member **30**. The hole **43** is formed approximately in the center of the body **41**. The end of the body **41** is inserted into the top of the split body **21**.

The body **41** also has a protuberant part **42** formed on its peripheral tapered surface **44**. The protuberant part **42** engages the cut groove **22** of the split collar **20**, like the protuberant part **34** of the fastening member **30**, and orients the body **41**. During the screwing of the tightening bolt **70** into the movable member **40** and while the bolt passes through the fastening member **30**, the protuberant part **42** also prevents the movable member **40** from rotating along with the rotation of the tightening bolt **70**.

A stopper **38** is provided in the fastening member **30**. The stopper **38** comprises a known screw or the like and is screwed into a screw hole **39** of the fastening member **30** through a through hole **49** that has been placed in the movable member **40** alongside a screw hole **43** for the tightening bolt of the movable member **40**.

With the above construction, even when the tightening bolt **70** has been removed, the split sleeve **20** and the movable member **40** are prevented from dropping from the fastening member **30** into the pipe **50** as can be understood from FIG. **4**.

As is shown in FIG. **2**, the device **10** is installed at the installation part **51** of the pipe **50** when the fastening member **30** is on the installation part **51** and the movable member **40** is inserted into the interior of the pipe **50**. The pipe **50** with the device **10** is integrally fastened to the installation member **60** by screwing in a tightening bolt **70** which has been inserted from below from the installation hole **61** of such an installation member **60** as a base board, etc. into the screw hole **43** of the movable member **40** through the fixing member **30** of the device **10**.

The device is further explained with reference to FIG. **5**. As the tightening bolt **70** is inserted into the movable member **40** of the fastening device **10** and screwed in the direction A, the main body part **41** of the movable member **40** is drawn with the force **W1** in the direction of the thick collar **23** of the split sleeve **20**. The cut groove **22** formed in the length direction of the split sleeve **20** enables the sleeve **20** to be expanded radially by the force exerted by the outer peripheral tapered surface **44** of the movable member **40**. This compresses the front tapered surface **24** of the split sleeve **20**.

In addition, the force **W1** also acts with the force **W2** on the outer peripheral tapered surface **35** of the fastening member **30** that slidingly contacts the lower side tapered surface **25** of the split sleeve **20**.

The compressive forces **W1** and **W2** produce balancing forces **W3** and **W4** on the tapered surfaces **25, 24** of the sleeve **20** which contact the members **30** and **40** slidingly. At the same time, they produce the compressive forces **W5** and **W6**. The stresses from the split sleeve **20** along the direction of the pipe **50** are indicated by an arrow mark in the Figure and are broken into the forces **W7** and **W8** that compress the fastening member **30** and the movable member **40** with respect the split sleeve **20**, thereby fastening the pipe **50** and the installation member **60** integrally.

In other words, the forces **W1** and **W2** are widely dispersed in a uniform fashion over the various cooperating tapered surfaces **24, 25, 35, 44** of the split sleeve **20**, the fastening member **30** and the movable member **40** which have been inserted into the installation end part **51** of the pipe. This provides a high holding power for the pipe **50**.

As seen from FIG. **6**, it is possible to cause the movable member **40** to be inserted deeply into the split sleeve **20** by increasing the tightening force applied on the tightening bolt **70**. This might be used, for example, where a thin pipe **52** is fastened and to further expand the exemplary split sleeve **20** by providing a larger diameter part **44a** of the outer peripheral tapered surface **44**. This makes it possible to cause the split sleeve **20** to tightly adhere to the inner surface of the pipe, thereby securely fastening the sleeve.

FIG. 7 shows an example of how two pipes are connected by using a device according to this invention. There is a pipe **80**. An angular pipe **81** serves as an installation member. There is a tightening bolt **82** and under its head there is a spring washer **83** above a flat washer **84**. A bolt-passage hole is provided in the angular pipe **81**.

As has been explained, the tightening force exerted by the tightening bolt is dispersed to the fastening member and to the split sleeve through the movable member. This makes it possible to firmly compress the inner surface of the pipe over a wide area. This provides a strong holding force on the installation member, enabling the pipe to be securely fastened without becoming shaky.

It is possible to increase or decrease the amount of the insertion of the movable member into the split sleeve by modifying the tightening length of the tightening bolt. This adjusts the amount of the radial opening of the split sleeve, which makes it possible to cause the split sleeve to press firmly to the inner wall of the pipe, thereby fastening the pipe to the installation member.

Although the present invention has been described in relation to particular embodiments thereof, many other variations and modifications and other uses will become apparent to those skilled in the art. It is preferred, therefore, that the present invention be limited not by the specific disclosure herein, but only by the appended claims.

What is claimed is:

1. A pipe fastening device for fastening an end of a pipe to an installation member, the fastening device comprising:

a tubular sleeve split longitudinally and having an exterior size generally corresponding to the interior of the pipe for being installed in the end of the pipe; the sleeve having a main tubular body; the main tubular body having a tubular inner surface including a lower tapered surface which increases in diameter downward along the tubular body and an upper tapered surface above the lower tapered surface which increases in diameter upward along the tubular body;

a lower pipe fixing member at the lower end of the pipe and engagable with the installation member, and including a first outer peripheral tapered surface which is approximately the shape of a frustum of a cone generally corresponding in pitch angle and diameter to the inner lower tapered surface of the main tubular body and being slidable along the inner lower tapered surface;

a movable member at the top part of the main body and including a respective second outer peripheral tapered surface which is approximately the shape of a frustum of a cone generally corresponding in pitch angle and diameter to the upper tapered surface of the main tubular body and installed in the main body and being slidable along the upper inner tapered surface; and

fastening means at the installation member and extending to the fastening device for pulling the movable member toward the installation member at the end of the pipe, for moving the lower fixing member and the upper movable member securely against the inner tapered surfaces of the main tubular body to expand the main tubular body and to securely engage the tubular body with the interior of the pipe.

2. The pipe fastening device of claim **1**, wherein the fastening means comprises a bolt with a head which engages the installation member to which the pipe is fastened and the bolt extending through the fixing member into the movable member and engaging the movable member such that tightening the bolt pulls the movable member toward the installation member.

3. A pipe fastening device for fastening an end of a pipe to an installation member, the fastening device comprising:

a tubular sleeve split longitudinally and having an exterior size generally corresponding to the interior of the pipe for being installed in the end of the pipe; the sleeve having a main tubular body; the main tubular body having a tubular inner surface including a lower tapered surface which increases in diameter downward along the tubular body and an upper tapered surface above the lower tapered surface which increases in diameter upward along the tubular body;

a lower pipe fixing member at the lower end of the pipe and engagable with the installation member, and including a first outer peripheral tapered surface which is approximately the shape of a frustum of a cone generally corresponding in pitch angle and diameter to the inner lower tapered surface of the main tubular body and being slidable along the inner lower tapered surface;

a moveable member at the top part of the main body and including a respective second outer peripheral tapered surface which is approximately the shape of a frustum of a cone generally corresponding in pitch angle and diameter to the upper tapered surface of the main tubular body and installed in the main body and being slidable along the upper inner tapered surface;

fastening means at the installation member and extending to the fastening device for pulling the moveable member toward the installation member at the end of the pipe, for moving the lower fixing member and the upper moveable member securely against the inner tapered surfaces of the main tubular body to expand the main tubular body and to securely engage the tubular body with the interior of the pipe, the longitudinally split main tubular body defining a groove therealong;

a first protuberant part on the fixing member for engaging in the groove in the main tubular body, for preventing relative rotation of the fixing member and the main tubular body; and

a second protuberant part on the moveable member for engaging in the groove of the tubular body for preventing relative rotation of the moveable member with respect to the main tubular body.

4. The pipe fastening device of claim **3**, wherein the fastening means comprises a bolt which extends from the installation member to which the pipe is fastened and the bolt extending through the fixing member into the movable member and engaging the movable member such that tightening the bolt pulls the movable member toward the installation member.

5. The pipe fastening device of claim **3**, further comprising a fastening stopper for holding the fixing member and movable member against total separation such that after removal of the fastening means which draws the movable member toward the installation member, the fixing member and the movable member are still held so that they will not fall apart from the main tubu-

lar body, thereby enabling subsequent assembly of the pipe fastening device and the installation member.

6. The pipe fastening device of claim 5, wherein the fastening stopper comprises a bolt extending between the fixing member and the movable member and being tightenable for holding them together.

7. A pipe fastening device for fastening an end of a pipe to an installation member, the fastening device comprising:

a tubular sleeve split longitudinally and having an exterior size generally corresponding to the interior of the pipe for being installed in the end of the pipe; the sleeve having a main tubular body; the main tubular body having a tubular inner surface including a lower tapered surface which increases in diameter downward along the tubular body and an upper tapered surface above the lower tapered surface which increases in diameter upward along the tubular body;

a lower pipe fixing member at the lower end of the pipe and engagable with the installation member, and including a first outer peripheral tapered surface which is approximately the shape of a frustum of a cone generally corresponding in pitch angle and diameter to the inner lower tapered surface of the main tubular body and being slidable along the inner lower tapered surface, the fixing member including a flange of a size to rest against the end of the pipe and also to rest on the installation member which fixes the fixing member at the end of the pipe;

a moveable member at the top part of the main body and including a respective second outer peripheral tapered surface which is approximately the shape of a frustum of a cone generally corresponding in pitch angle and diameter to the upper tapered surface of the main tubular body and installed in the main body and being slidable along the Upper inner tapered surface; and

fastening means at the installation member and extending to the fastening device for pulling the moveable member toward the installation member at the end of the pipe, for moving the lower fixing member and the upper movable member securely against the inner tapered surfaces of the main tubular body to expand the main tubular body and to securely engage the tubular body with the interior of the pipe.

8. A pipe fastening device for fastening an end of a pipe to an installation member, the fastening device comprising:

a tubular sleeve split longitudinally and having an exterior size generally corresponding to the interior of the pipe for being installed in the end of the pipe; the sleeve having a main tubular body; the main tubular body having a tubular inner surface including a lower tapered surface which increases in diameter downward along the tubular body and an upper tapered surface above the lower tapered surface which increases in diameter upward along the tubular body;

a lower pipe fixing member at the lower end of the pipe and engagable with the installation member, and including a first outer peripheral tapered surface which is approximately the shape of a frustum of a cone generally corresponding in pitch angle and diameter to the inner lower tapered surface of the main tubular body and being slidable along the inner lower tapered surface;

a moveable member at the top part of the main body and including a respective second outer peripheral tapered surface which is approximately the shape of a frustum of a cone generally corresponding in pitch angle and diameter to the upper tapered surface of the main tubular body and installed in the main body and being slidable along the upper inner tapered surface;

fastening means at the installation member and extending to the fastening device for pulling the moveable member toward the installation member at the end of the pipe, for moving the lower fixing member and the upper moveable member securely against the inner tapered surfaces of the main tubular body to expand the main tubular body and to securely engage the tubular body with the interior of the pipe; and

a fastening stopper for holding the fixing member and movable member against total separation such that after removal of the fastening means which draws the movable member toward the installation member, the fixing member and the movable member are still held so that they will not fall apart from the main tubular body, thereby enabling subsequent assembly of the pipe fastening device and the installation member.

* * * * *

United States Patent [19]

Borenstein et al.

[11] **Patent Number: 4,651,771**

[45] **Date of Patent: Mar. 24, 1987**

[54] **HYDRANT PROTECTIVE CAP AND COVER STRUCTURE AND OPERATING WRENCH THEREFOR**

[76] Inventors: **Daniel W. Borenstein,** 3014 N. Southport, Chicago, Ill. 60657; **Arnold L. Borenstein,** 2818 W. Chase, Chicago, Ill. 60645

[21] Appl. No.: **886,330**

[22] Filed: **Jul. 7, 1986**

[51] **Int. Cl.**[4] **F16K 35/06;** E03B 9/06; E03B 9/14

[52] **U.S. Cl.** ..... **137/296;** 81/121.1; 81/439; 220/85 P; 220/284; 220/367; 137/382; 137/800

[58] **Field of Search** ..... 137/272, 296, 371, 377, 137/381, 382, 382.5, 800; 220/284, 85 P, 253, 256, 367, 374; 81/121.1, 124.4, 125.1, 177.2, 437, 439; 251/291

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Primary Examiner—George L. Walton

Attorney, Agent, or Firm—Richard J. Myers & Assoc.

[57] **ABSTRACT**

A fire hydrant cap and cover assembly which is provided with a hydrant operating wrench therefor. The cap of the assembly has an interior threaded cap portion which attaches to the threaded portion of the hydrant water outlet discharge pipe. The exterior cover is rotatably attached to the cap (and rotates with respect thereto) through an annular groove on the cap, the groove engaging a ring bead fixed on the cover. A pentagonal shaped wrench is inserted into the pentagonal shaped recessed portion in the cap by way of a circular opening in the exterior of the cover to engage the cap. Through rotation of the cap, its interior threaded portion can be unscrewed from the threaded hydrant water outlet discharge pipe to enable the removal of the cap and cover assembly. This arrangement prevents tampering with the hydrant water discharge pipe. The cap recessed portion is provided with a fluid drain and vent aperture communicating with the hydrant valve and indication of leaking on the seat.

20 Claims, 4 Drawing Figures

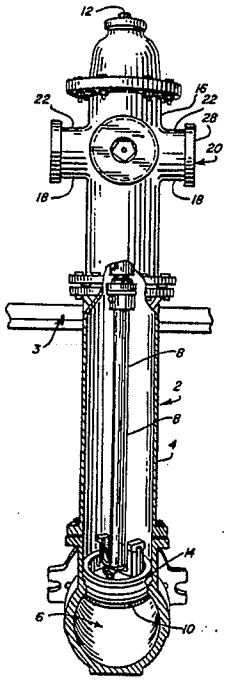


FIG. 1

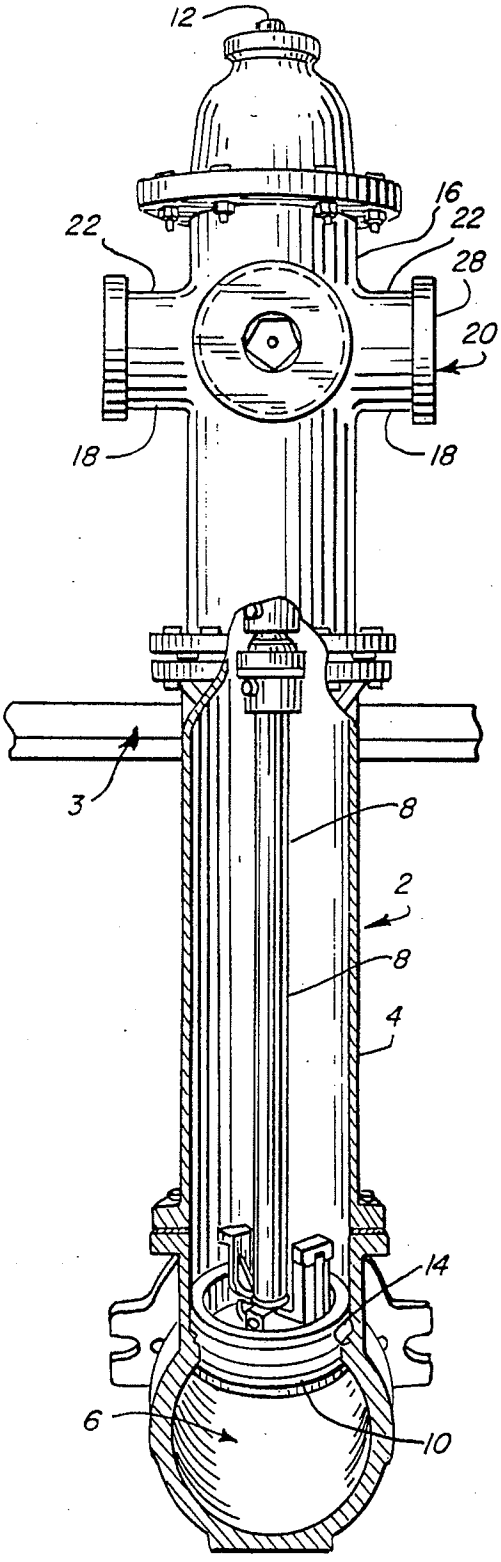


FIG. 2

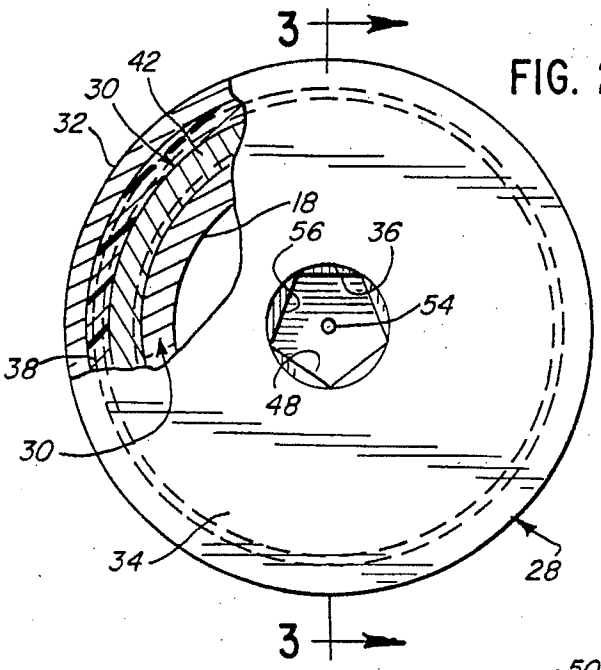
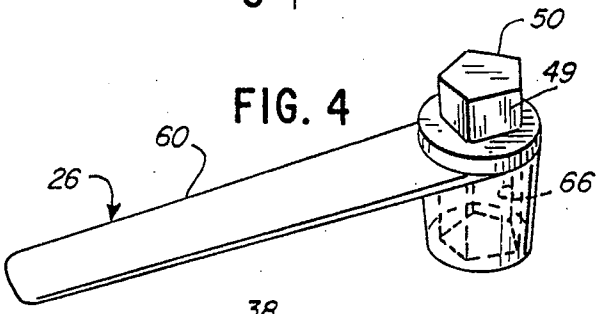


FIG. 4



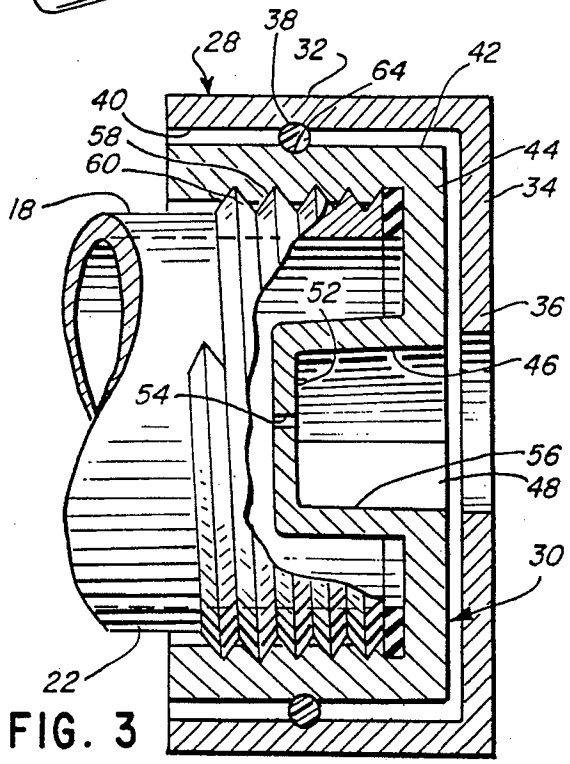


FIG. 3

HYDRANT PROTECTIVE CAP AND COVER STRUCTURE AND OPERATING WRENCH THEREFOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to improvements in fire hydrants in particular for providing a tamper proof hydrant arrangement.

2. Description of the Prior Art

It is known for instance, to provide for a fire hydrant which may not be operated by unauthorized persons and which can be operated only by use of a key member, the hydrant being arranged so that the outlets there are normally covered and can only be uncovered when the hydrant is unlocked and in particular the hydrant valve nut member is concealed which is located on top of the hydrant and which controls the opening and closing of the hydrant valve. Such an arrangement is shown by U.S. Pat. No. 2,869,576 to W. Kennedy. Further there is shown U.S. Pat. No. 3,450,148 to R. Mongelluzzo et al. a locking arrangement for a hydrant that includes lock bolt means removably received in the bolt opening in the housing and in the valve stem for securing the cap means over the valve stem and preventing movement of the valve stem. Further U.S. Pat. No. 3,556,131 to R. Diaz discloses a hydrant arrangement where the nut that operates the valve is concealed and a special wrench is required to engage the nut through a limited access. Similarly U.S. Pat. No. 3,623,498 to G. Manahan provides for a top barrel bonnet to the top of hydrant for limiting operation of the hydrant valve. Further U.S. Pat. No. 3,709,249 to R. Diaz provides for a novel wrench arrangement to operate the top collar covering the hydrant valve whereby the hydrant valve. U.S. Pat. No. 3,935,877 to Peter Franceschi provides for a tamper proof locking system for a standard fire hydrant which includes a cap assembly that fits over the valve stem of the hydrant and can only be operated by a special wrench.

None of the foregoing patents disclose an arrangement for locking the hydrant discharge pipe which extends out of the side of the hydrant as distinguished from the top of the hydrant which has the nut for operating the valve stem. However, U.S. Pat. No. 4,182,361 to E. Oakey does disclose a fire hydrant protection device which prevents unauthorized individuals from tampering with the fire hydrant where there is provided an outlet cap member having a projection for engagement by a special wrench for removal or installation of the cap and a cover member movably associated therewith preventing access to the cap member projection. Also such a tamper proof device can be installed over the valve actuating mechanism, however, there is nothing in the prior art that shows an arrangement for preventing access to the hydrant discharge pipe which includes a cap and cover therefor provided with suitable orifice structure operated by a wrench that will open the discharge pipe as well as the hydrant valve.

Removal of the cap in the prior art under emergency conditions is quite difficult and introduction of any foreign objects under the rotating cap makes it most difficult to remove the cap for hydrant operation. In addition firefighters must carry several tools to operate the hydrant, one for the standard pentagon projection and one for the prior art device.

SUMMARY OF THE INVENTION

A fire hydrant serves a number of purposes. Its primary function is to provide water for fighting fires and for public service equipment. A secondary function is to periodically flush water lines to eliminate sediment or treatment chemicals from potable water supplies. To allow firefighters and other authorized personnel access to water and still limit unauthorized people from wasting water and possibly damaging hydrants or contaminating them, the hydrant manufacturing industry standardized on a pentagon shaped projection on the top of the hydrant to operate the hydrant valve, which is located below ground to prevent freezing. The same projection extends from the the caps that cover the hydrant discharge ports. Operation of a hydrant is simple in that one tool is used to remove the hydrant cap so hoses can be connected after which the same tool is used to turn on the hydrant valve. Unfortunately, a large pipe wrench can be used to accomplish the same operation so that anybody can operate the hydrant at any time.

The subject invention disclosed herein which is simple and comparatively inexpensive to manufacture prevents unauthorized personnel from using fire hydrants, and allows operation of all standard hydrants, with one simple tool.

My novel inventive arrangement provides for a fire hydrant cap and cover assembly unit complete with a wrench for operating same, the interior of the cap being threaded and releaseably attachable to the hydrant discharge port or pipe structure and wherein exterior cover is rotatably mounted on the cap through means of an annular groove and bead or receiving structure, with the cover rotatably protecting the cap removal. A multi-faceted wrench is insertable into a facet orifice structure in the cap, the wrench passing through an opening in the exterior cover in order to engage the cap. Rotation of the cap permits removal of the cap and cover assembly from the hydrant discharge structure.

It is therefore a general object of my invention to provide for a novel cover and cap arrangement for protecting the discharge port of the hydrant against tampering.

Another object of my invention is to provide for a tamper proof design for a hydrant discharge pipe that will remove the cap and cover of my invention by the use of a single wrench or tool which can also rotate the valve member atop of the fire hydrant.

It is another object of my invention to provide for a wrench having a recessed socket for operating the valve stem and a projection socket structure for operating the cap and cover arrangement protecting the hydrant discharge structure.

It is a further object of my invention to provide for an apertured structure in the hydrant cap said socket portion to provide indication of shut off valve leakage and ventilating of the interior of the hydrant and the valve structure of the hydrant.

It is a further object of my invention to provide for wrench receiving orifice in my novel cover described above that is in line with the recessed portion of the cap to permit insertion of the wrench through the cover orifice and into the recessed portion of the cap.

These and other objects of my invention will become apparent from reference to the following description and appended claims, and from the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of a fire hydrant of this invention, partially in sections of this invention;

FIG. 2 is a side elevational view of the novel cap and cover arrangement protectively covering the discharge pipe of the fire hydrant, partially in section;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2 and illustrative in partial view of the novel relationship between the hydrant discharge pipe and the cap and cover of my invention; and

FIG. 4 is a perspective view of the novel wrench used in my inventive arrangement for locking and unlocking my novel cap and cover structure protecting the hydrant discharge arrangement and preventing tampering therewith.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to FIG. 1 there is shown a fire hydrant 2 which includes an upright hollow or cylindrical tubular body portion 4. The housing or body portion 4 contains the valve structure 6 which includes a vertically extending valve stem mechanism 8 which at its lower end carries the valve body 10 and at the upper end thereof carries the valve nut or operating pentagonally shaped end structure 12 which is operated in suitable fashion by some form of wrench to raise or lower the valve member 10 against the valve seat 14 located at the lower end of the cylindrical tubular member 4. It is noted that the fire hydrant tube extends below the ground 3 a sufficient amount so that the valve 10 and its seat 14 is below the frost line. Projecting from the upper portion 16 of the tubular housing 4 is a plurality of discharge ports or pipes 18.

The novel cap and cover structure 20 of my invention is located at the outer end 22 of each discharge port or pipe 18. The cap and cover structure 20 when in place functions as an end cap structure for a hydrant and that is to prevent unrestricted flow of the water from the hydrant when the valve 10 is off of its seat 14 permitting the water in the ground or pipelike passageway 24 from passing up the tubular housing core when the valve nut 12 has been operated so as to raise the valve 10 off of the valve seat 14. Such operation of the hydrant to allow water out of the discharge port is a normal operation and commonly known and further showing in such patents as U.S. Pat. No. 2,869,576 to Kennedy and U.S. Pat. No. 4,182,361 to Oakey. My novel arrangement lies in the particular construction of the cap and cover arrangement 20 that covers the end of the discharge port or pipe 18 and which cap and cover structure 20 is operated by the novel wrench mechanism 26 as shown in FIG. 4 all of which is to be described below.

With reference now to FIGS. 1–3 and in particular with reference to FIGS. 2 and 3 my novel hydrant discharge port or pipe cap and cover structure 20 includes the outer cover member 28 and the inner cap member 30. The cover member 28 has an annular cylindrical wall 32, an outer annular cover plate part 34 which is provided with an annular aperture or orifice 36 and an annular ring or bead member 38 affixedly attached to the inside wall portions 40 of the annular or cylindrical wall 32. The cap member 30 is located underneath the cover member 28 which covers the cap member 30. The cap member 30 is provided with an annular skirt or cylindrical wall 42 which is in vertical alignment with and covered by wall or skirt 32 of the cover member 28. In the cap member 30 is also provided with a vertically extending end portion or cylindrical plate part 44 which is in horizontal alignment with the cover plate part 34 of the cover 32, the plate portion 34 similarly covering the plate portion 44.

The cover end plate part 44 is provided with a recessed portion or plug receiving female portion or part 46 of pentagonal shape including five sides 48 to receive the pentagonal sides 49 plug portion 50 of the novel wrench structure 26 shown in FIG. 4. The plug 10 and the recess 46 and recess 66 are tapered shape. The recessed portion of female receptacle part 46 is also provided with a bottom or a plate part 52 which is provided with an orifice or aperture 54 in the form of a venting or drain opening. It is to be noted that the pentagonal shaped bore 56 of the recessed portion 46 has a diameter which is slightly smaller than the diameter of the aperture or orifice 36 of the cover plate part 34. The orifice 54 in the centrally located bottom plate 52 is in axial alignment with the central portion of the door 56 and the aperture or orifice 36.

The discharge port or pipe 18 of the hydrant 2 is provided with an outer threaded end portion 58 and is threadingly received in the interior threaded portion 60 of the skirt 42 of the cap member 30. The skirt part 42 has an outer diameter surface 62 that is provided with a semi-circular recess or groove 64 outwardly of cap skirt threaded portion 60. The annular ring or bead member 38 is received in the cap groove portion 64 and allows the cover member 28 to rotate about the inner cap member 30 as the bead 38 moves relative to the groove 64.

The wrench structure 26 is provided with a handle 65 and a female recessed portion or valve stem pentagonally shaped nut receiving recessed portion 66 which is placed over the pentagonally shaped valve nut 12 for rotating the valve stem mechanism 8 and raising the valve member 10 off the valve seat 14 or lowering the valve member back on the valve seat 14. It is seen that the male portion 50 and the female portion 66 of the wrench are in vertical alignment with one another and the same wrench can be used for either rotating the female recessed portion 46 of the caps 30 or rotating the valve projection or nut 12. It is noted that the recessed portion of the cap 30 and the aperture 36 of the cover 28 and the vent 54 in the recessed portion 46 are all in axial alignment with the axis of the discharge pipe 18. Easy access is obtained to the cap with the wrench by such an arrangement. The vent 54 permits discharging or venting fluid from the valve passages or interior of the hydrant tube 4. It is noted that the threaded portion of the cap and cover are in vertical alignment with the female recessed portion 46 of the cap 30 to provide for easy torquing and untorquing movement of the cover and cap structure 20 with respect to the cap discharge 18.

It will be appreciated that various modifications could be made of the construction. For instance, the bead or ring member 38 could be fixed to the cap member 30 and rotate in a groove in the cover member 28. The cover plate can be of plastic material or of metal and the female plug portion 46 can be of brass or other material. To provide for easy access of the wrench within the cover and cap arrangement the opening in the cover is slightly larger than the opening in the cap to provide for easy entrance the cap socket 46. The outer cover 28 can be steel or ductile iron or brass or polycarbonate or other suitable plastic material. The sealer cap 30 can be a casting of ductile iron or brass or polycarbonate or other suitable plastic material. The

bearing surfaces **38, 64** can be the ball bearings or mating ridges **38**, and grooves, **64** and either one or two rings **38** can be used depending on material. A rubber gasket material or synthetic gasket can be provided where necessary to prevent metal seizing.

Thus what is provided by noval invention is a fire hydrant cap and cover assembly **20** and a hydrant operating wrench therefor. The cap **30** has an interior threaded skirt portion **42** which attaches to the threaded portion **22** of the hydrant water outlet discharge pipe **18**. The exterior cover **32** is rotatably attached to the cap **30** through an annular groove **64** on the cap, the groove **64** engaging a ring bead **38** fixed on the cover. A pentagonal shaped projection **50** of wrench **26** is inserted into the pentagonal shaped recessed portion **46** in the cap by way of a circular opening **36** in the exterior **34** of the cover to engage the cap. Through rotation of the cap, its interior threaded portion **42** can be unscrewed from the threaded hydrant water outlet discharge pipe **18** to enable the removal of the cap and cover assmebly. This arrangement prevents tampering with the hydrant water discharge pipe. The cap recessed portion **46** is provided with a fluid drain and vent aperture **54** communicating with the hydrant valve **10** and seat **14** for appropriate draining and venting of the hydrant.

The foregoing description and drawings merely explain and illustrate the invention and the invention is not limited thereto, except insofar as the appended claims are so limited, as those skilled in the art who have the disclosure before them will be able to make modifications and variations therein without department from the scope of the invention.

What is claimed is:

1. A fire hydrant comprising:

a vertically extending tubular body for communication with a supply of water;

a valve in the body for controlling the flow of water out of the discharge pipe;

a horizontally extending water discharge pipe;

a cap and cover arrangement on the outlet end of the discharge pipe and extending generally horizontally outward thereof and including:

a cap releasibly mounted on the outlet end of the pipe in generally horizontal alignment with the pipe;

a cover mounted on the cap for rotation with respect thereto and in general axial alignment with the cap and the pipe;

said cap having generally a cap wrenching receiving means and adapted to be engaged by an associated wrench for rotatable removement from the end of the pipe;

said cover having a cover wrench receiving aperture in axial alignment with the cap receiving means and said cup receiving means being disposed within the interior of the pipe end through which the associated wrench passes for reception by the wrench receiving means for easy torquing and untorquing movement of said cap and said cover with respect to the outlet end of the discharge pipe;

said cover and said cap defining an annular space therebetween and in which is located coupling means for providing for rotational movement of said cover relative to said cap and said cover substantially encompasses said cap.

2. The invention according to claim **1**, and

said cap wrench receiving means including a recess portion within the cap.

3. The invention according to claim **1**, and

said cap having an outer wall portion between the hydrant valve and the cover and a vent and drain means in said outer wall portion allowing contaminants to exit from the valve and discharge pipe.

4. The invention according to claim **1**, and

a wrench having a cap operator engageable with said cap wrench receiving means in mounting and removing said cap carrying said cover and;

said hydrant having a valve stem connecting with valve and being in said upright hollow tubular portion and said wrench having a valve operating portion and a valve operator on said hydrant connecting with said stem and said wrench having the valve operating portion engageable with said valve operator to open and close the valve.

5. The invention according to claim **4**, and

said wrench comprising handle and an end portion connecting with the handle and having the cap operator on one side thereof and having the valve operator on the other side thereof.

6. The invention according to claim **1**, and

said cap having a cap wall over the end of the discharge pipe and a skirt portion extending axially of and surrounding the end of the discharge pipe and having pipe coupling means on the skirt releasibly coupling with the pipe.

7. The invention according to claim **6**, and

said wrench receiving means comprising a recess portion in the cap end wall and extending inwardly thereof into said pipe;

said cover having a cap wall extending over the cap wall and axially outward thereof and a cover skirt and extending around the cap skirt and the cap and the cover coupling means including being disposed between the skirts and connecting the same for rotation of the outer cover skirt relative to the inner cap skirt.

8. The invention according to claim **6**, and

said wrench receiving means comprising an axially extending pentagonal shaped recess portion adapted to receive of a complimentally shaped pentagonal projection portion of a cap removal wrench.

9. The invention according to claim **6**, and

said cap and cover coupling means including bearing means attached to and between the skirts;

said bearing means including an annular member fixed one of the skirts and groove in the other skirt constrained by the annular member for axially movement and rotatably supported for movement relation to the annular member.

10. The invention according to claim **1**, and

said cap having a pentagonal recess and said valve having a pentagonal projection and a wrench having a pentagonal projection for fitting the cap recess and a pentagonal recess for fitting the valve means, all of the recesses and projections be of the same fitting diametric dimension for opening and closing the valve means and discharge pipe.

11. The invention according to claim **1**, and

the vent in the cap recessed portion, the base of the cap recess portion, and the cover aperture all being in general axial alignment with one another.

12. A protection device for fire hydrants comprising:

a cap having a water closed outer end portion adapted from releasible securement to the end of the hydrant discharge pipe and having a horizontal

cap wrench receiving means on the outer end portion;

a cover being rotatably mounting the cover on the cap over the cap end portion and including a wrench receiving aperture on its outer end in alignment with the recess for receiving a wrench therethrough and extending into the recess for removal of the cap and cover carried thereby from the discharge pipe while allowing easy torquing and untorquing movement of said cap and said cover with respect to the discharge pipe end;

said cap receiving means adapted to be disposed within the interior of the discharge pipe end, said cover and said cap defining an annular space therebetween and in which is located coupling means for providing for rotational movement of said cover relative to said cap and said cover substantially encompasses said cap.

13. The invention according to claim 12, and

said cap wrench receiving means including a recess portion within the cap.

14. The invention according to claim 12, and

a wrench having a cap operator engageable with said cap wrench receiving means in mounting and removing said cap carrying said cover.

15. The invention according to claim 12, and

said cap having an outer wall portion between the hydrant valve and the cover and a vent drain means in said outer wall portion allowing contaminants to exit from the valve and discharge pipe.

16. The invention according to claim 12, and

a wrench having a cap operator engageable with said cap wrench receiving means in mounting and removing said cap carrying said cover and;

said hydrant having a valve stem connecting with valve and being in said upright hollow tubular portion and said wrench having a valve operating portion and a valve operator on said hydrant connecting with said stem and said wrench having a valve operating portion engageable with said valve operator to open and close the valve;

said wrench comprising handle and an end portion connecting with the handle and having the cap operator on one side thereof and having the valve operator on the other side thereof.

17. The invention according to claim 12, and

said cap having a cap wall over the end of the discharge pipe and a skirt portion extending axially of and surrounding the end of the discharge pipe and having pipe coupling means on the skirt releasibly coupling with the pipe;

said cover having a cap wall extending over the cap wall and axially outward thereof and a cover skirt and extending around the cap skirt and the cap and the cover coupling means including bearing means being disposed between the skirts and connecting the same for rotation of the outer cover skirt relative to the inner cap skirt;

said cap and cover coupling means including bearing means attached to and between the skirts;

said bearing means including an annular member fixed one of the skirts and groove in the other skirt constrained by the annular member for axially movement and rotatably supported for movement relation to the annular member.

18. The invention according to claim 12, and

said cover wrench receiving aperture being slightly larger diametrically than said cap wrench receiving means by receiving an associated wrench therethrough.

19. The invention of claim 1 or claim 12, and a wrench for operating the valve and discharge pipe caps and covers protective device including a wrench socket portion and a wrench handle;

the wrench socket portion being at one end of the handle and having a projection portion on one side and at one end of the handle and on the opposite side and at the same end thereof a socket recessed portion having the same shape and internal diameter as the projection portion, the recessed portion being substantially an inversion of the projection portion, the wrench projection portion being adapted to extend through an aperture in the hydrant discharge pipe cover and into operative engagement with the conforming recessed portion of the associated cap in alignment with the cover aperture and rotatably carrying the cover portion and adapted to be releasably mounted on the end of the hydrant discharge pipe, the wrench recessed portion being adapted to couple on the conforming protection nut of the hydrant valve operator and operative thereof.

20. The invention according to claim 19, and

said socket wrench recess portion having pentagonal shaped configuration for attachments to and operative of the hydrant valve complimentally pentagonal shaped nut, said socket wrench projection portion being a pentagonal sided shaped projection for attachment to and operative of the hydrant discharge pipe attaching cap and cover.

* * * * *

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United States Patent [19]

Lanham

[11] Patent Number: 6,017,177

[45] Date of Patent: Jan. 25, 2000

[54] **MULTI-TIER SECURITY FASTENER**

[75] Inventor: **Thomas R. Lanham**, Boston, N.Y.

[73] Assignee: **McGard, Inc.**, Orchard Park, N.Y.

[21] Appl. No.: **08/938,800**

[22] Filed: **Oct. 6, 1997**

[51] **Int. Cl.**[7] **F16B 23/00**

[52] **U.S. Cl.** **411/410**; 411/402; 411/910; 81/121.1; 81/124.4; 81/451; 81/436

[58] **Field of Search** 411/402, 403, 411/407, 410, 910; 81/121.1, 124.4, 451, 436

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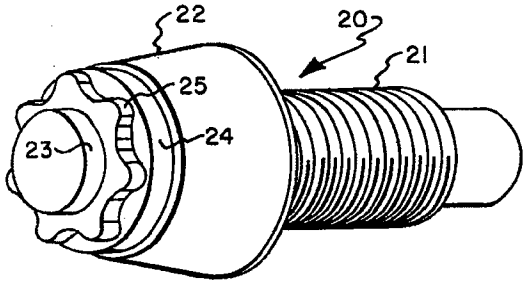
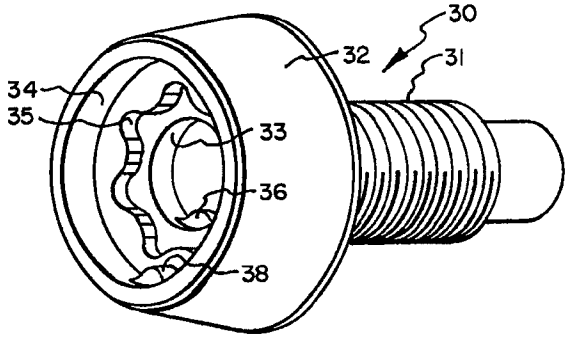
Primary Examiner—Flemming Saether
Attorney, Agent, or Firm—Joseph P. Gastel

[57] **ABSTRACT**

A multi-tier security fastener in the nature of a nut or bolt having a body with a first tier having a lobed drive surface, and second and third cylindrical tiers on opposite sides of the first tier, with all three tiers having different effective diameters. The second and third cylindrical tiers can have irregularities in the nature of a lobe or a depression.

17 Claims, 5 Drawing Sheets





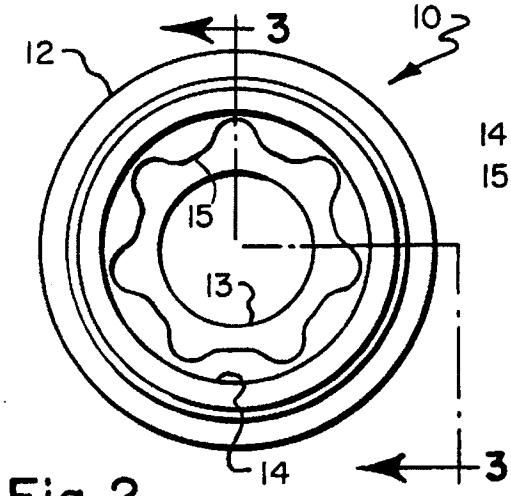


Fig. 2.

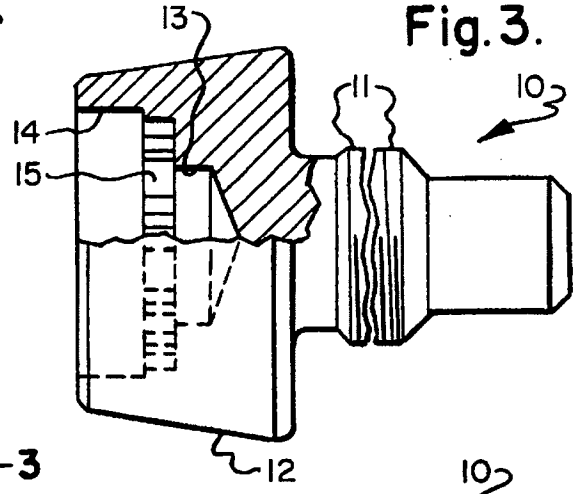


Fig. 3.

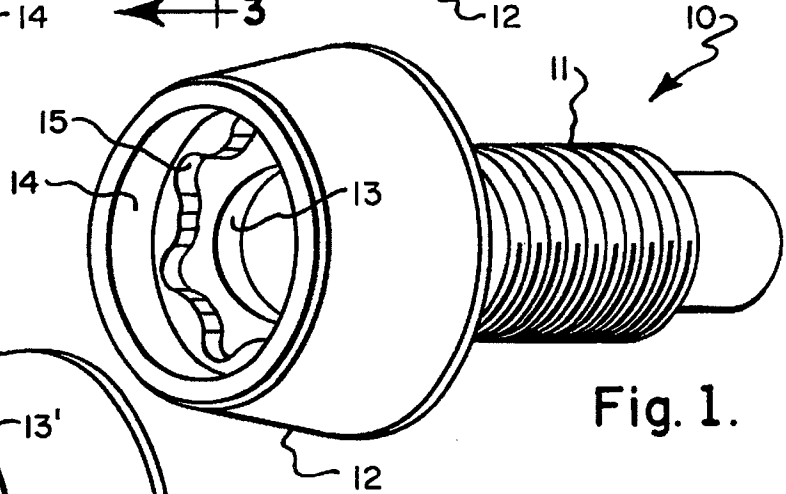
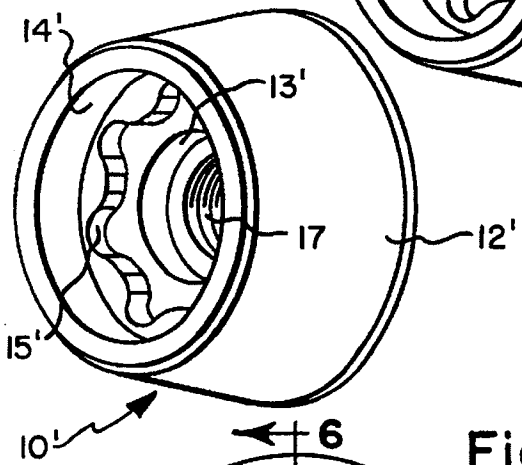


Fig. 1.

Fig. 4.



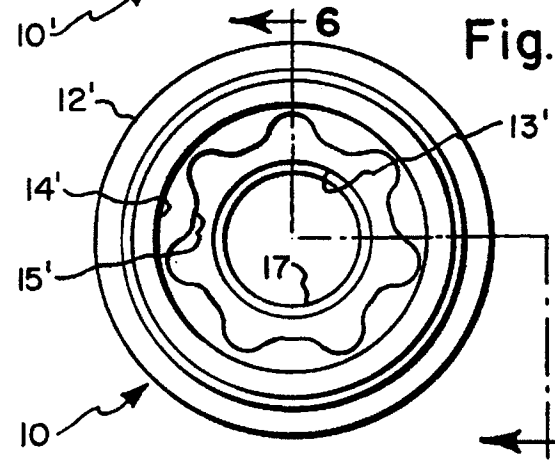
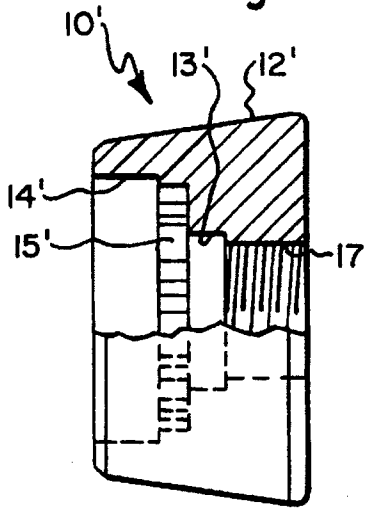


Fig. 5.

Fig. 6.



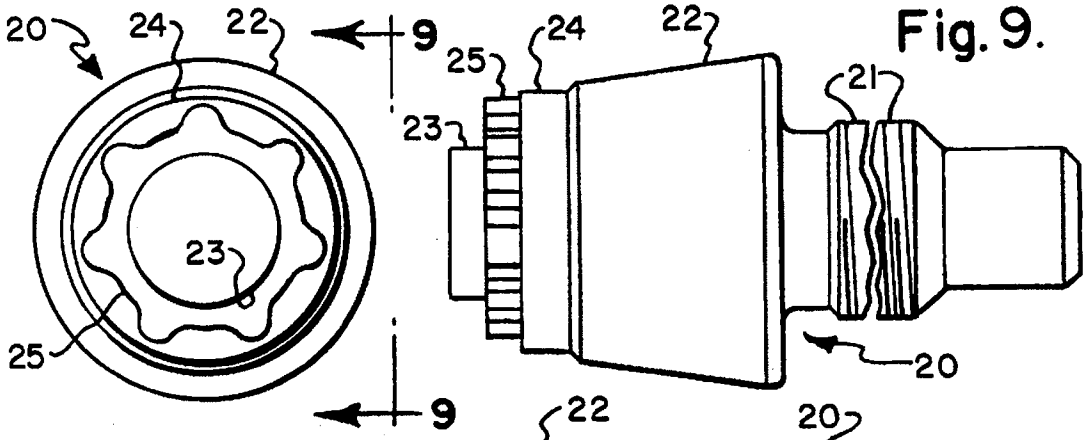


Fig. 8.

Fig. 9.

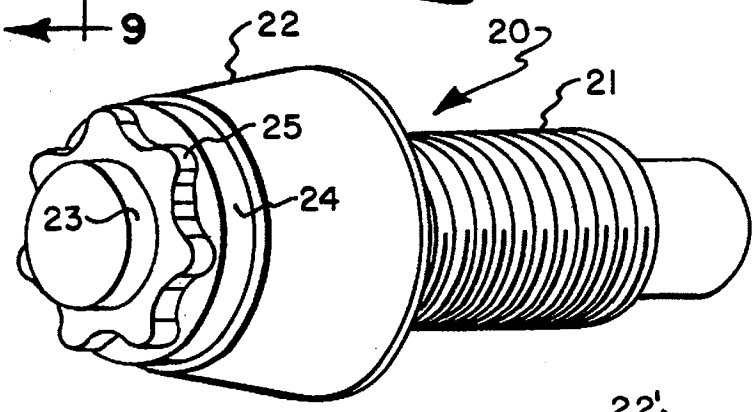
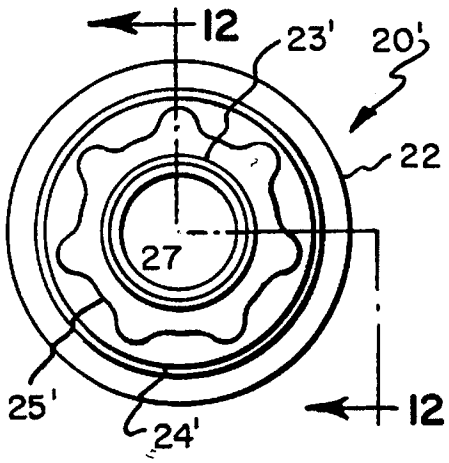


Fig. 7.

Fig. 11.



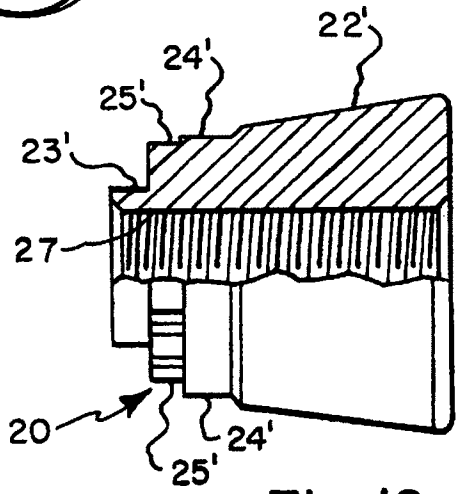


Fig. 12.

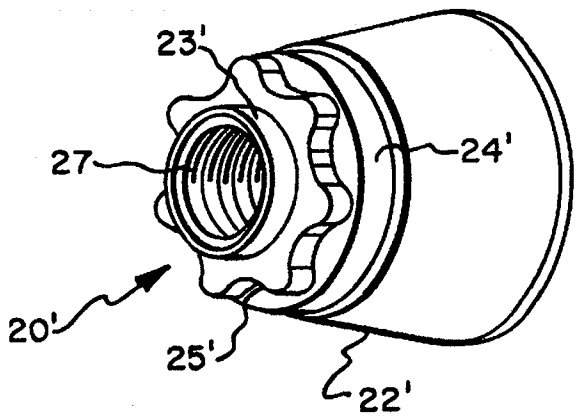


Fig. 10.

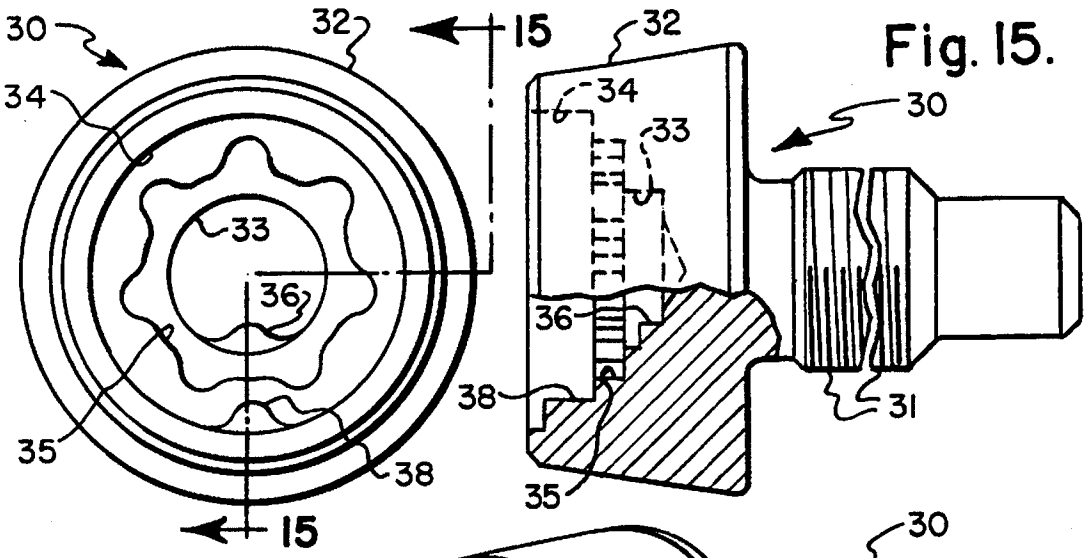


Fig. 15.

Fig. 14.

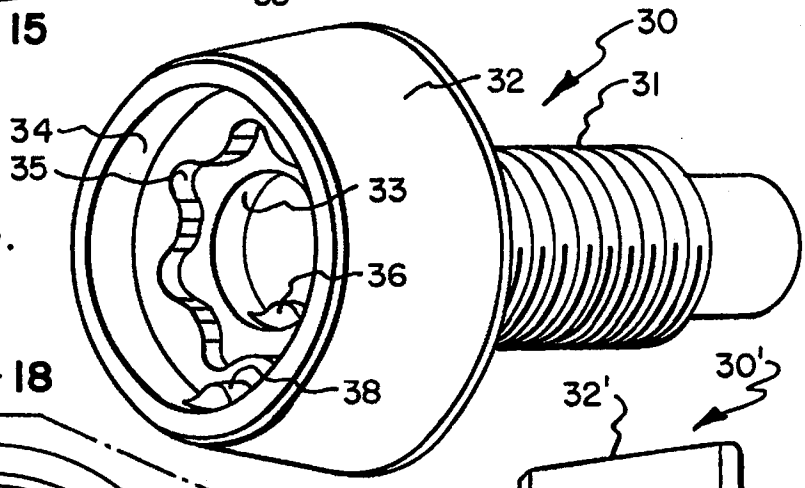


Fig. 13.

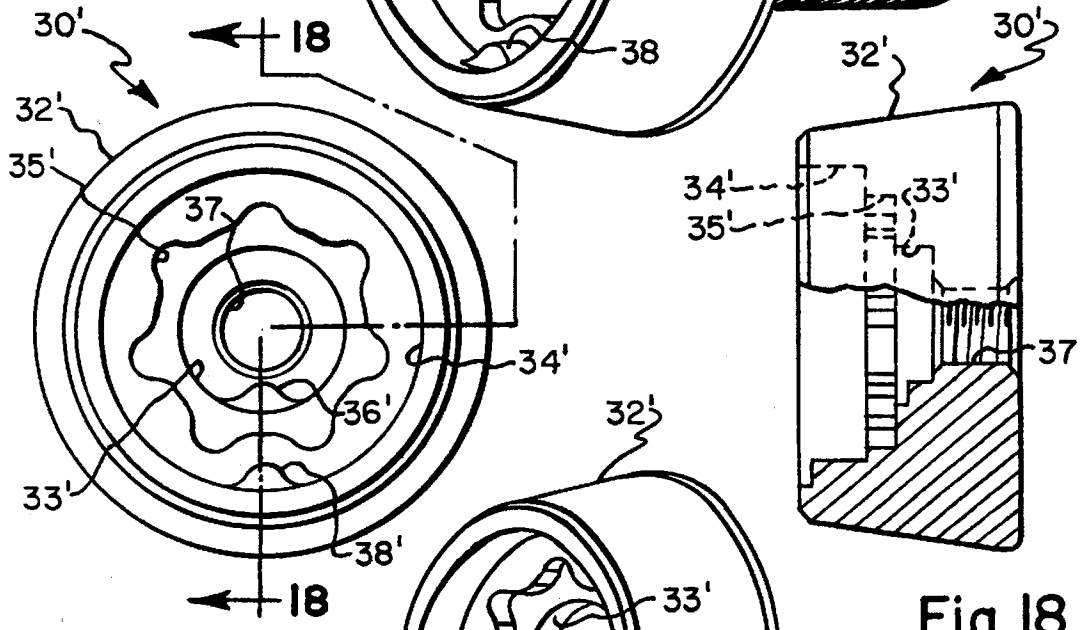


Fig. 17.

Fig. 18.

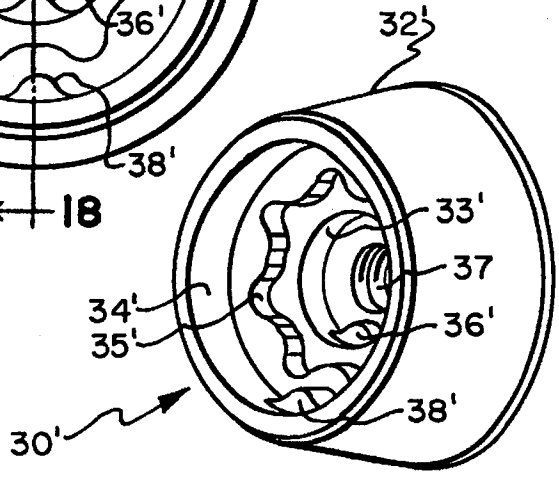


Fig. 16.

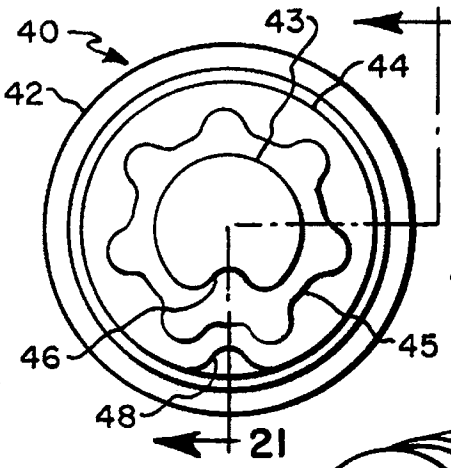


Fig. 20.

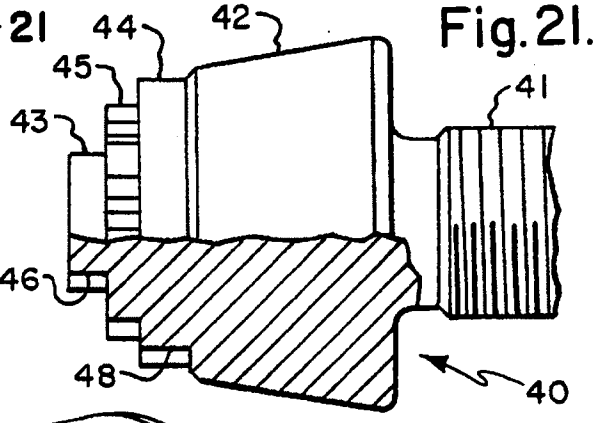


Fig. 21.

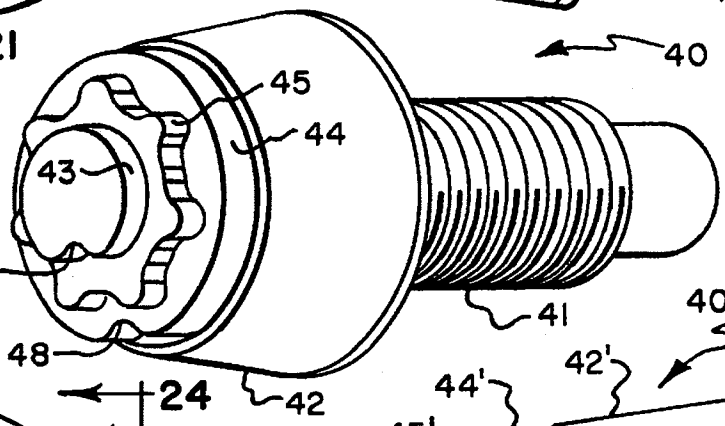


Fig. 19.

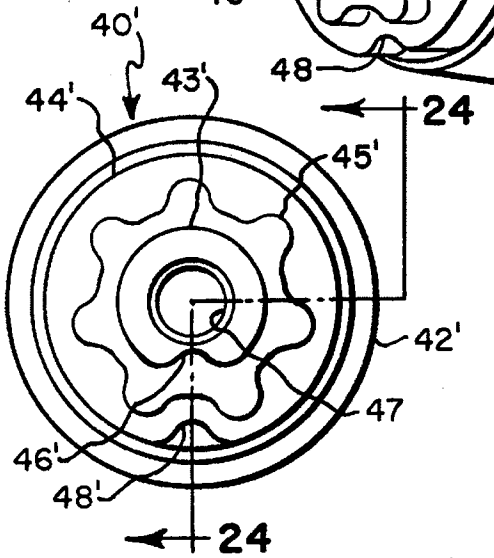


Fig. 23.

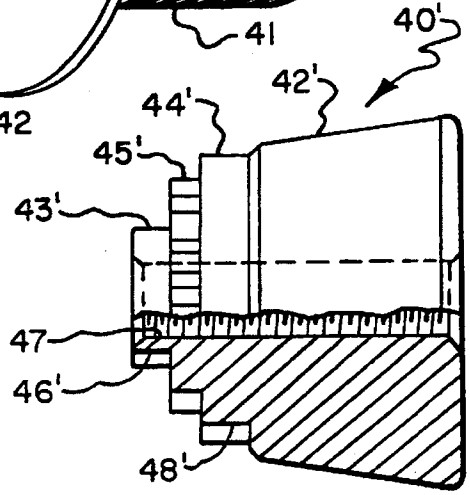


Fig. 24.

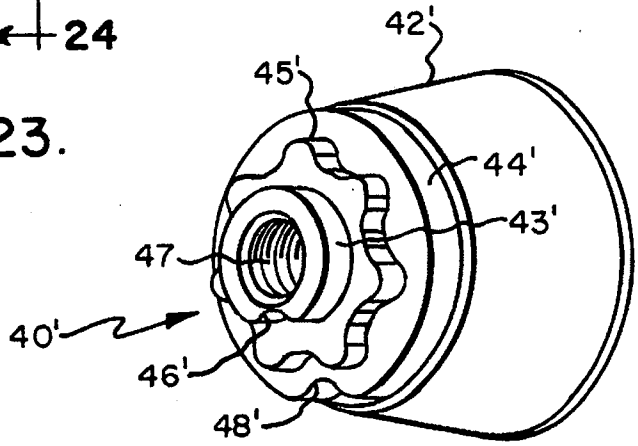


Fig. 22.

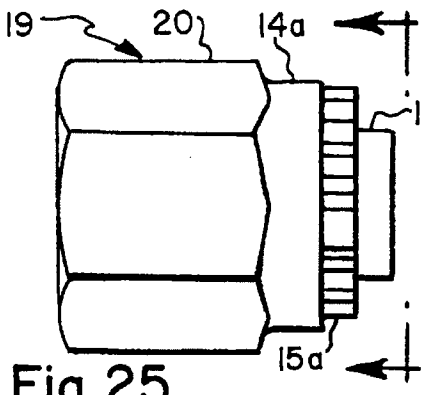


Fig. 25.

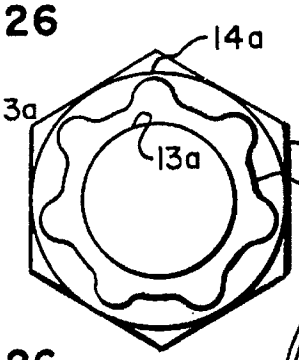


Fig. 26.

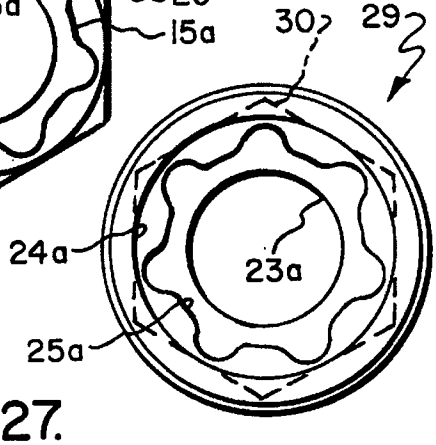


Fig. 28.

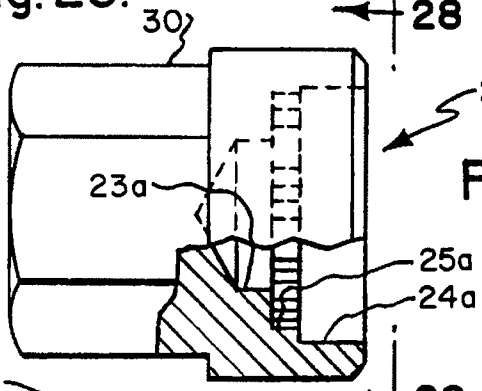


Fig. 27.

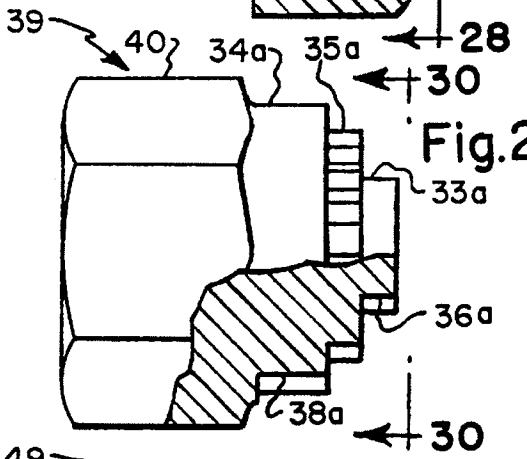
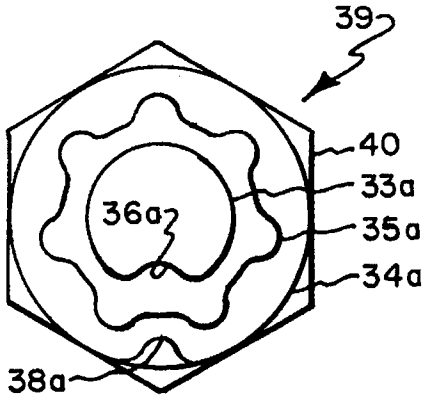


Fig. 29.

Fig. 30.



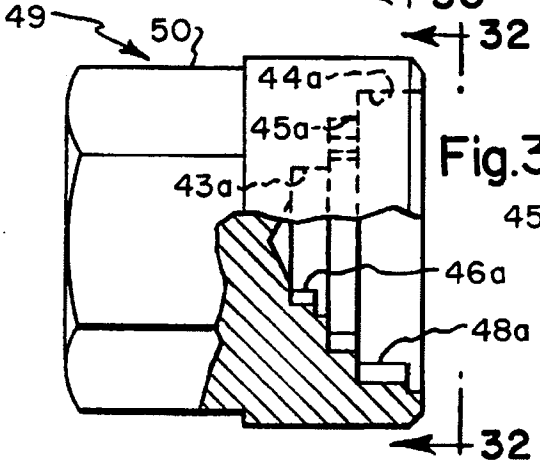
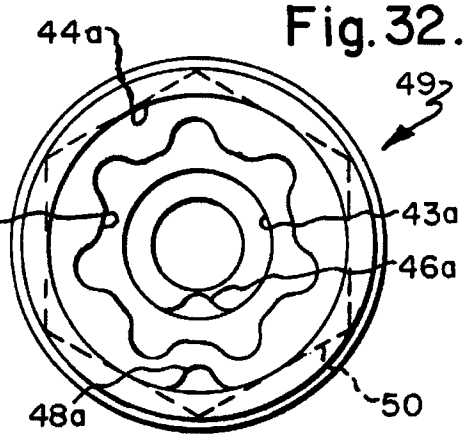


Fig. 31.

Fig. 32.



MULTI-TIER SECURITY FASTENER

CROSS-REFERENCE TO RELATED APPLICATIONS

Not Applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

BACKGROUND OF THE INVENTION

The present invention relates to an improved security fastener having a multi-tier drive.

There are numerous types of security fasteners known. Many of these security fasteners include an undulating groove or ridge which receives a mating key. However, fasteners of these types require the groove or ridge to have sufficient axial length so as to provide a relatively large area of contact with a mating key which is required to turn them. The greater the axial length, the greater will be the ability of unauthorized tools to turn the fasteners. Additionally, fasteners having a relatively long axial length are fabricated by complex machining operations which increases their costs.

BRIEF SUMMARY OF THE INVENTION

It is one object of the present invention to provide a multi-tier drive for a security fastener, such as a nut or bolt, wherein each of the tiers has a different diameter and a relatively shallow axial length or depth, which does not provide sufficient axial surface for receiving an unauthorized tool in turning relationship.

Another object of the present invention is to provide an improved security fastener having a multi-tier drive wherein each of the tiers is of relatively shallow axial length and which is used with a multi-tier key which engages each of the tiers to provide a positive turning relationship with the multi-tier drive.

A further object of the present invention is to provide an improved security fastener having a multi-tier drive wherein one of the tiers is a drive tier utilized to receive the torque applied thereto by an appropriate key and one or more other tiers provide the dual function of guiding an associated key into turning relationship with the drive tier, and, when the key is in the proper turning relationship, also stabilize the key against cocking relative to the drive tier which receives the torque.

Yet another object of the present invention is to provide a fastener with a multi-tier drive which can be fabricated with a simple cold forming or forging operation.

A still further object of the present invention is to provide a security fastener having a multi-tier drive wherein the configuration of stabilizing tiers can be changed in practically infinite amounts to produce a practically infinite number of patterns in a relative simple manner.

Other objects and attendant advantages of the present invention will readily be perceived hereafter.

The present invention relates to a multi-tier security fastener comprising a body, a first tier on said body, a key-receiving drive pattern on said first tier, and second and third key-receiving tiers on said body adjacent said first tier.

The present invention also relates to a multi-tier security fastener comprising a body, a first tier on said body, a drive pattern on said first tier having a first diameter, a second tier on said body adjacent said first tier and having a second diameter which is different from said first diameter, a key-guiding and stabilizing surface on said second tier, and an irregularity in said second tier.

The various aspects of the present invention will be more fully understood when the following portions of the specification are read in conjunction with the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. **1** is a perspective view of a bolt having the improved multi-tier security drive of the present invention;

FIG. **2** is an end elevational view of the fastener of FIG. **1**;

FIG. **3** is a fragmentary cross sectional view taken substantially along line **3—3** of FIG. **2**;

FIG. **4** is a perspective view of a nut having the improved security drive shown on the bolt of FIG. **1**;

FIG. **5** is an end elevational view of the nut of FIG. **4**;

FIG. **6** is a view, partially in cross section, taken substantially along line **6—6** of FIG. **5**;

FIG. **7** is a perspective view of another bolt embodiment of t present invention having a male multi-tier security drive construction;

FIG. **8** is an end elevational view of the embodiment of FIG. **7**;

FIG. **9** is a fragmentary side elevational view taken substantially in the direction of arrows **9—9** of FIG. **8**;

FIG. **10** is a perspective view of the security drive of FIGS. **7–9** as applied to a nut;

FIG. **11** is an end elevational view of the embodiment of FIG. **10**;

FIG. **12** is a side elevational view, partially in cross section, taken along line **12—12** of FIG. **10**;

FIG. **13** is another embodiment of the multi-tier drive on a bolt, with the multi-tier drive including protuberances in the form of lobes on certain of the tiers;

FIG. **14** is an end elevational view of the embodiment of FIG. **13**;

FIG. **15** is a fragmentary cross sectional side elevational view taken substantially along line **15—15** of FIG. **14**;

FIG. **16** is a perspective view of a nut having the security drive shown on the bolt of FIG. **13**;

FIG. **17** is a end elevational view of the embodiment of FIG. **16**;

FIG. **18** is a cross sectional view taken substantially along line **18—18** of FIG. **17**;

FIG. **19** is a perspective view of another bolt embodiment having a male multi-tier drive with depressions in certain of the tier;

FIG. **20** is an end elevational view of the embodiment of FIG. **19**;

FIG. **21** is a fragmentary cross sectional view taken substantially along line **21—21** of FIG. **20**;

FIG. **22** is a nut embodiment having the male multi-tier drive of FIG. **19**;

FIG. **23** is an end elevational view of the embodiment of FIG. **22**;

FIG. **24** is a cross sectional view taken substantially along line **24—24** of FIG. **23**;

FIG. **25** is a side elevational view of a key which can be used with the embodiments of FIGS. **1–6**;

FIG. **26** is an end elevational view taken substantially in the direction of arrows **26—26** of FIG. **25**;

FIG. **27** is a side elevational view, partially broken away of a key which can be used with the embodiments of FIGS. **7–12**;

FIG. **28** is an end elevational view taken substantially in the direction of arrows **28—28** of FIG. **27**;

FIG. **29** is a side elevational view, partially broken away, of a key which can be used with the embodiment of FIGS. **13–18**;

FIG. **30** is an end elevational view taken substantially in the direction of arrows **30—30** of FIG. **29**;

FIG. **31** is a side elevational view, partially broken away, of a key which can be used with the embodiments of FIGS. **19–24**; and

FIG. **32** is an end elevational view taken substantially in the direction of arrows **32—32** of FIG. **31**.

DETAILED DESCRIPTION OF THE INVENTION

In FIGS. **1–3** a bolt **10** is shown having a threaded shank **11** with a frustoconical body or head **12** having a female multi-tier drive therein consisting of a small diameter cylindrical tier **13**, a large diameter cylindrical tier **14**, and a multi-lobed drive tier **15** centrally located between tiers **13** and **14**. Each of the tiers is sufficiently shallow so as to prevent the use of standardized tools for unauthorized removal. In this respect, in a given embodiment of a bolt having a thread diameter of metric M6 or ¼"-20, the axial lengths of the tiers were as follows: Tier **13** was approximately 0.057 inches, tier **15** was approximately 0.035 inches, and tier **14** was approximately 0.078 inches. Each of these tiers was sufficiently shallow so that an unauthorized tool could not get a sufficiently tight grip in any one of the tiers so as to provide sufficient torque so as to turn bolt **10** when it was in a properly installed position.

A nut embodiment **10'** of the bolt **10** is shown in FIGS. **4–6** wherein the primed numerals correspond to the unprimed numerals of FIGS. **1–3** and represent identical structure. However, the nut embodiment of FIGS. **4–6** has a threaded bore **17** to receive a bolt.

A key which can be used to drive the embodiments of FIGS. **1–6** is shown in FIGS. **26** and **27**. Key **19** includes a hexagonal head **20** which can be received in the socket of a suitable tool or which can receive a wrench. Protruding outwardly from hexagonal head are three male tiers **13***a*, **14***a* and **15***a* which are received in the surfaces of tiers **13**, **14** and **15**, respectively. The meshing of complementary engaging surfaces **15** and **15***a* will provide the drive for turning the fasteners of FIGS. **1–6**, and the cylindrical surfaces **13***a* and **14***a* will be closely located within cylindrical surfaces **13** and **14**, respectively, to serve the dual function of guiding the key **19** into engagement with the multi-tier female drive and also stabilizing the engaged surfaces **15***a* and **15** against cocking.

In FIGS. **7–9** a security bolt **20** is shown having a threaded shank **21**, a frustoconical body or head **22** and cylindrical tiers **23** and **24** protruding therefrom with a lobed drive tier **25** therebetween. Each of the tiers **23**, **24** and **25** is sufficiently shallow so that it cannot be properly gripped with a wrench, and the lobed tier is sufficiently thin so that it cannot provide a sufficient surface contact for a punch. Also, the frustoconical head **22** cannot be gripped by a wrench. The dimensions of the various tiers are analogous to those described above relative to FIGS. **1–3**.

A nut embodiment **20'** of the bolt of FIGS. **7–9** is shown in FIGS. **10–12** wherein primed numerals represent structure which is identical to the unprimed numerals of FIGS. **7–9**. However, nut fastener **20'** has a threaded bore **27**.

The key **29** of FIGS. **27** and **28** is used for driving the fastener of FIGS. **7–12**, and it includes a hexagonal head **30** which is received in a suitable handle or which can have a wrench applied thereto. The key **29** has a plurality of tiers **23***a*, **24***a* and **25***a* which engage the tiers **23**, **24** and **25**, respectively, of FIGS. **7–9** and the tiers **23'**, **24'** and **25'**, respectively, of the embodiment of FIGS. **10–12** to effect a driving relationship therewith. Here again, the lobe tiers **25** and **25***a* provide the driving relationship between the key and the fasteners, and the tiers **23***a* and **24***a* serve the dual function of guiding the key into proper engagement with the associated fasteners and also stabilizing the key against cocking on the very shallow lobed tier.

In FIGS. **13–15** another bolt embodiment **30** of the present invention is disclosed having a threaded shank **31**, a frustoconical body or head **32** and a plurality of female tiers including tiers **33** and **34** and drive tier **35**. All of these tiers are of shallow extent analogous to the extent of FIGS. **1–3**. Portions of tiers **33** and **34** are cylindrical. In addition, however, tiers **33** and **34** have lobes or irregularities **36** and **38**, respectively, which serve the functions of providing additional lobes for receiving torque and prevent the use of the types of tools which are inserted into a bore for applying a turning torque. By varying the circumferential placement of the lobes within their respective tiers, they can provide an infinite number of keyed combinations for turning the bolt. In this respect, assuming that each lobe can be moved in one degree increments in each of its tiers, this would provide 237,600 combinations, assuming that the lobed tier **35** was not changed. The foregoing number of combinations can also be increased by increasing the number of lobes in tiers **33** and **34** and varying their positions. It will be appreciated that irregularities in the form of splines or any other type of protuberance can be used instead of the lobe type of protuberances. Also, the female tiers can be polygonal.

A nut embodiment **30'** is shown in FIGS. **16–18** wherein primed numerals corresponding to the unprimed numerals of FIGS. **13–15** represent identical elements of structure. In addition the nut embodiment **30'** has a threaded bore **37**.

A key **39** is shown in FIGS. **29** and **30** for turning the fasteners of FIGS. **13–18**, and it includes a hexagonal head **40** which can be inserted into a suitable socket of a handle or which can have a wrench applied thereto. Key **39** includes a plurality of tiers **33***a*, **34***a* and **35***a* which are placed in engagement with tiers **33**, **34** and **35**, respectively, of FIGS. **13–15** and the tiers **33'**, **34'** and **35'**, respectively, of FIGS. **16–18**. Additionally, the male tiers **33***a* and **34***a* have depressions **36***a* and **38***a* which receive lobes or irregularities **36** and **38** of FIGS. **13–15** or lobes **36'** and **38'** of FIGS. **16–18**. The tiers **33** and **34** of FIGS. **13–15** and the tiers **33'** and **34'** of FIGS. **16–18** have the functions of guiding the key **39** into position and stabilizing it after it has been fully positioned by preventing cocking of the key.

In FIGS. **13–15** lobes or irregularities **36** and **38** are shown on both tiers **33** and **34**, respectively, and in FIGS. **16–18** lobes or irregularities **36'** and **38'** are shown on both tiers **33'** and **34'**, respectively. However, it will be appreciated that there can be an embodiment with only one lobe on one of the tiers, or there can be an embodiment with only one lobed tier such as **35** or **35'** and only one additional tier having a lobe or irregularity thereon. Additionally, in an embodiment of the foregoing type having only two tiers,

such an embodiment should have an index of at least 0.625, as defined hereafter. In FIGS. **19–21** another multi-tier fastener **40** in the nature of a bolt is shown which includes a threaded shank **41**, a head or body **42** and a multi-tier male drive on body **42** consisting of tiers **43, 44** and lobed drive tier **45**. There are depressions or irregularities **46** and **48** in cylindrical tiers **43** and **44**, respectively. The depressions can be of any suitable shape. The tiers **43, 44** and **45** are shallow and they have the dimensions substantially as described above relative to FIGS. **1–3**. The depressions **46** and **48** provide additional torque-receiving surfaces and can have their positions varied to provide additional key-receiving configurations.

In FIGS. **22–24** a nut embodiment **40'** is shown wherein the primed numerals correspond to the structure of the unprimed numerals of FIGS. **19–21**. In addition, the nut embodiment **40'** has a threaded bore **47**.

A key **49** for turning the fastener embodiments of FIGS. **19–24** is shown in FIGS. **31** and **32**. Key **49** includes a hexagonal head **50** which can be mounted in a suitable handle or which can receive a wrench. Key **49** includes tiers **43***a*, **44***a* and **45***a* which mate with tiers **43, 44** and **45**, respectively, of the embodiment of FIGS. **19–21** and the tiers **43'**, **44'** and **45'**, respectively, of the embodiment of FIGS. **22–24**. Additionally, lobes **46***a* and **48***a* enter irregularities or depressions **46** and **48** of FIGS. **19–21** and **46'** and **48'** of FIGS. **22–24**. The tiers **43** and **44** serve the functions of guiding the key **49** into position and stabilizing it after it has been fully positioned, in addition to performing the other above described functions.

In FIGS. **19–21** depressions or irregularities **46** and **48** are shown on both tiers **43** and **44**, respectively, and in FIGS. **22–24** depressions or irregularities **46'** and **48'** are shown on both tiers **43'** and **44'**, respectively. However, it will be appreciated that there can be an embodiment with only one depression on one of the guiding and stabilizing tiers. Also there can be an embodiment with only one lobed tier such as **45** or **45'** and only one additional tier having a depression or irregularity thereon. Additionally, in an embodiment of the foregoing type having only two tiers, such an embodiment should have an index of at least 0.625, as defined hereafter.

In the embodiments of FIGS. **13–24** the guiding and stabilizing tiers are shown with each having a single irregularity in the nature of a lobe or depression. However, if desired each of these tiers may have multiple irregularities in the nature of lobes or other types of protuberances or depressions or combinations thereof.

While all of the embodiments have shown the lobed drive tier located between the two guiding and stabilizing tiers, it will be appreciated that they can be oriented with the guiding and stabilizing tiers adjacent each other in certain instances.

In all of the above multi-tier drive embodiments, the outer configuration of the body or head of the bolts and the outer configuration of the nuts is frustoconical, and thus cannot be satisfactorily gripped with a wrench.

For satisfactory operation of a security fastener having only a curvilinear groove or ridge, there must be an index of between about 0.625–1.0, which is the ratio of the axial length of the ridge or groove to its diameter. The same index must be realized when there are a plurality of tiers, as in the present situation, and this index is the sum of the individual ratios of the axial length of each tier to its diameter. In each of the multi-tier fasteners of FIGS. **1–24** there is an index of between about 0.625 and 1.0 which is the total of the ratios of each axial length of each tier to its diameter. For example, in FIGS. **1–6** the axial length of tier **13** is 0.057 inches; the axial length of tier **14** is 0.078 inches; and the axial length of tier **15** is 0.035 inches. The diameter of tier **13** is 0.188 inches; the diameter of tier **14** is 0.374 inches and the diameter of tier **15** is 0.307 inches. Thus, the ratio of the length to diameter of tier **13** is 0.057/0.188 or 0.302; the ratio of the length to the diameter tier **14** is 0.078/0.374 or 0.209; and the ratio of the length of diameter of tier **15** is 0.035/0.307 or 0.114. The sum of the individual ratios of each length to the diameter of each tier is therefore an index of 0.302 +0.209 +0.114 or 0.625. As noted above, for satisfactory operation there should be an index of between about 0.625 and 1.0.

It can thus be seen that the multi-tier drives associated with the above-described fasteners are manifestly capable of achieving the above-enumerated objects, and while preferred embodiments of the present invention have been disclosed, it will be appreciated that it is not limited thereto but may be otherwise embodied within the scope of the following claims.

I claim:

1. A multi-tier security fastener comprising a body having a longitudinal axis, a first tier on said body, a drive pattern on said first tier, said drive pattern being located on a first surface extending in an axial direction relative to said longitudinal axis, second and third key-receiving tiers on said body axially spaced from said first tier, second and third key-receiving surfaces on said second and third key-receiving tiers, respectively, extending in axial directions relative to said longitudinal axis, said first and second and third tiers having an index of between about 0.625 and 1.0 which is the sum of the ratios of the axial length to diameter of each tier.

2. A multi-tier security fastener as set forth in claim **1** wherein said second and third tiers include at least a portion which is a part of a cylindrical surface.

3. A multi-tier security fastener as set forth in claim **2** including a key-receiving irregularity extending in an axial direction in at least said second surface.

4. A multi-tier security fastener as set forth in claim **1** wherein said second and third surfaces are cylindrical.

5. A multi-tier security fastener as set forth in claim **1** including a key-receiving irregularity extending in an axial direction in at least said second surface.

6. A multi-tier security fastener as set forth in claim **5** including a second key-receiving irregularity on said third surface.

7. A multi-tier security fastener as set forth in claim **6** wherein said first tier is located between said second and third tiers.

8. A multi-tier security fastener as set forth in claim **5** wherein said first tier is located between said second and third tiers.

9. A multi-tier security fastener as set forth in claim **8** wherein said second and third tiers include cylindrical portions.

10. A multi-tier security fastener as set forth in claim **1** wherein said first tier is located between said second and third tiers.

11. A multi-tier security fastener as set forth in claim **1** wherein said body has an outer frustoconical configuration radially outwardly of said first, second and third tiers.

12. A multi-tier security fastener as set forth in claim **1** including a key having fourth, fifth and sixth surfaces for engaging said first, second and third key-receiving surfaces, respectively.

13. A multi-tier security fastener as set forth in claim **12** wherein said fourth surface engages said first surface in complementary engaging relationship.

14. A multi-tier security fastener as set forth in claim 13 wherein said fifth and sixth surfaces engage said second and third surfaces, respectively, in guiding and stabilizing relationship.

15. A multi-tier security fastener as set forth in claim 14 including mating irregularities between at least said second and fifth surfaces.

16. A multi-tier security fastener as set forth in claim 1 including a key having fourth and fifth, surfaces for engaging said first and second surfaces, respectively.

17. A multi-tier security fastener as set forth in claim 16 wherein said fourth surface engages said first surface in complementary engaging relationship.

* * * * *

US005704261A

United States Patent [19]

Strauch et al.

[11] Patent Number: 5,704,261

[45] Date of Patent: Jan. 6, 1998

[54] **TORQUE-TRANSMITTING TOOL**

[75] Inventors: **Martin Strauch**, Wuppertal; **Robert Hoy**, Ramscheid, both of Germany

[73] Assignee: **Wera Werk Hermann Werner GmbH & Co.**, Wuppertal, Germany

[21] Appl. No.: **491,933**

[22] PCT Filed: **Dec. 10, 1993**

[86] PCT No.: **PCT/EP93/03504**

§ 371 Date: **Jun. 22, 1995**

§ 102(e) Date: **Jun. 22, 1995**

[87] PCT Pub. No.: **WO94/14575**

PCT Pub. Date: **Jul. 7, 1994**

[30] **Foreign Application Priority Data**

Dec. 22, 1992 [DE] Germany 42 43 608.7

[51] **Int. Cl.**[6] **B25B 23/14**

[52] **U.S. Cl.** **81/467**; 81/477; 81/900; 81/436

[58] **Field of Search** 81/436, 460, 450, 81/64, 900, 177.6, 467, 471, 477; 76/119

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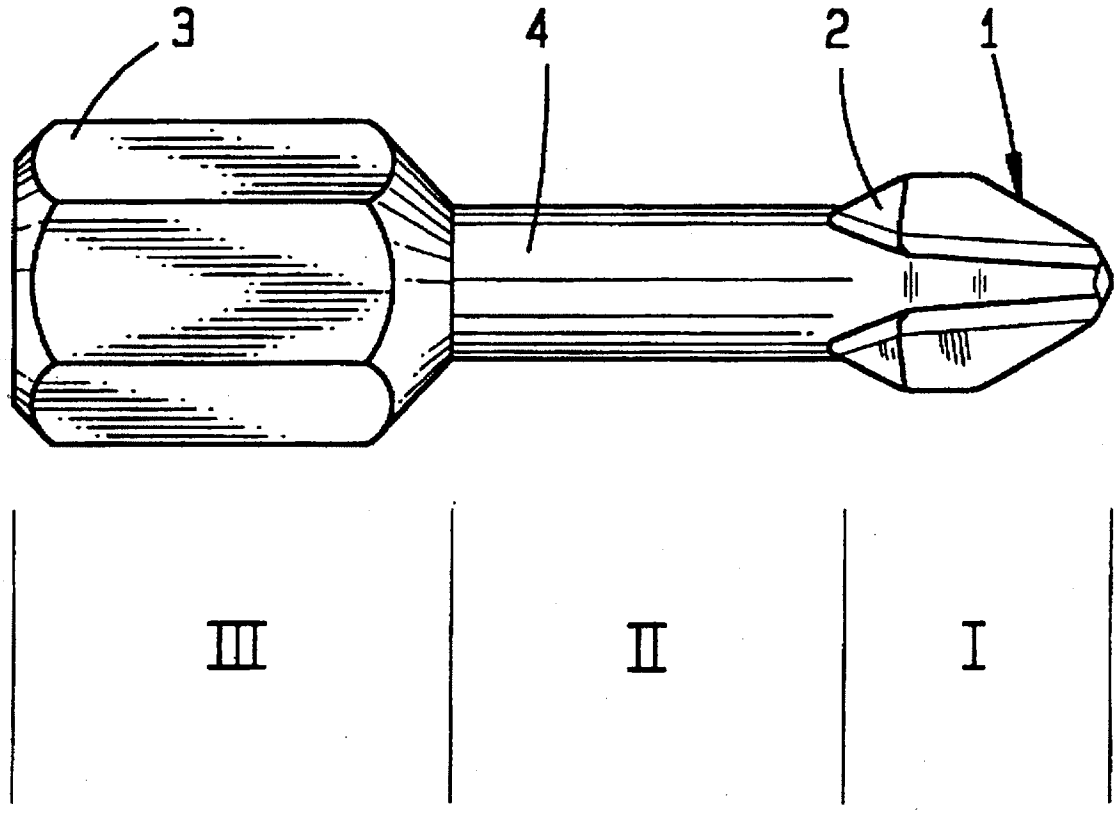
Primary Examiner—D. S. Meislin

Attorney, Agent, or Firm—Martin A. Farber

[57] **ABSTRACT**

A tool, particularly a torque-transmitting tool, such as a screwdriver or a screwdriver bit, having a shaft and a working region. In order advantageously to take up peak torques with such a tool, a damping region of lower hardness or lower torsion-bar constant than the working region is provided, associated with the shaft. For this purpose, the damping region can be subsequently annealed or have a different composition of material. The latter is preferably provided in the case of a tool of sintered metal.

12 Claims, 2 Drawing Sheets



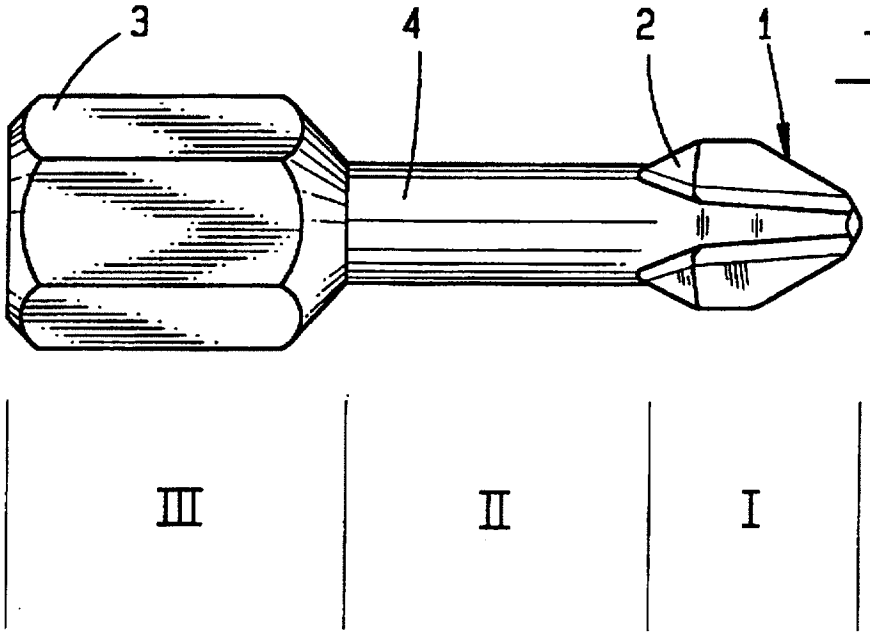


Fig. 1

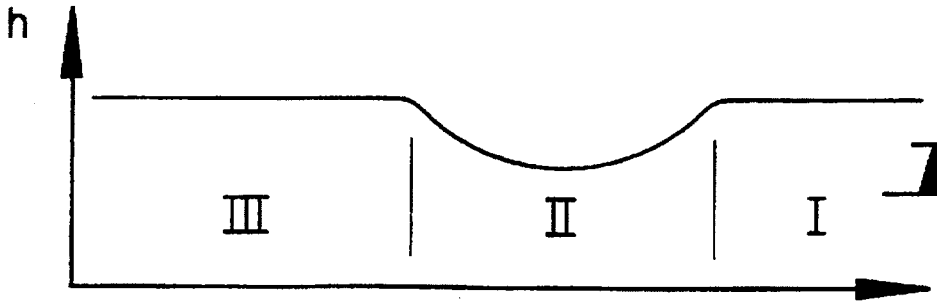


Fig. 2

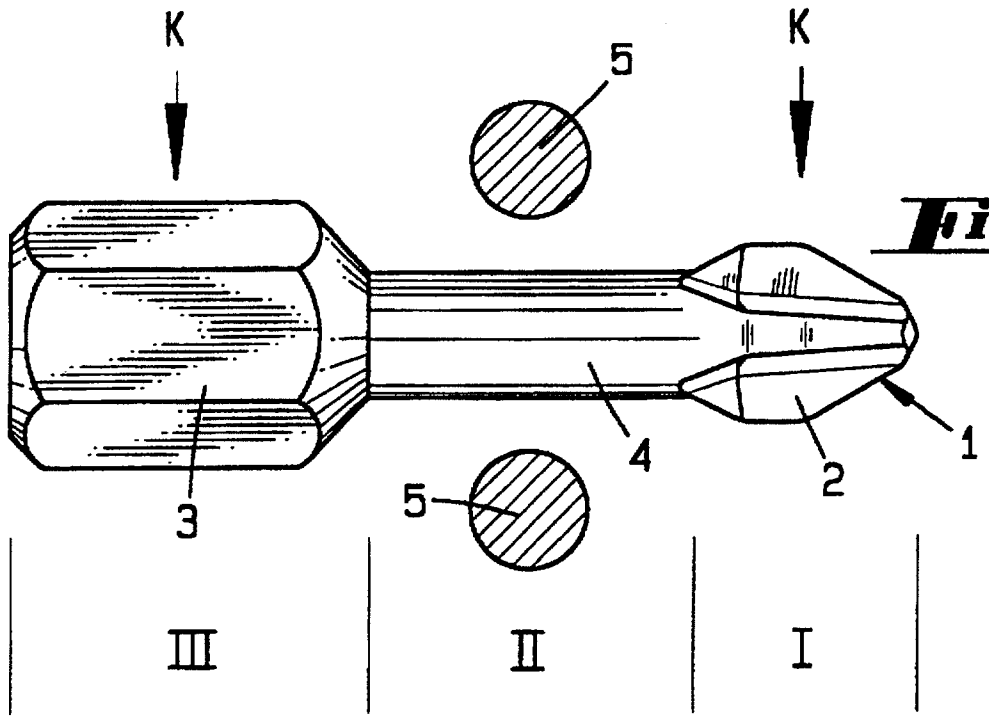
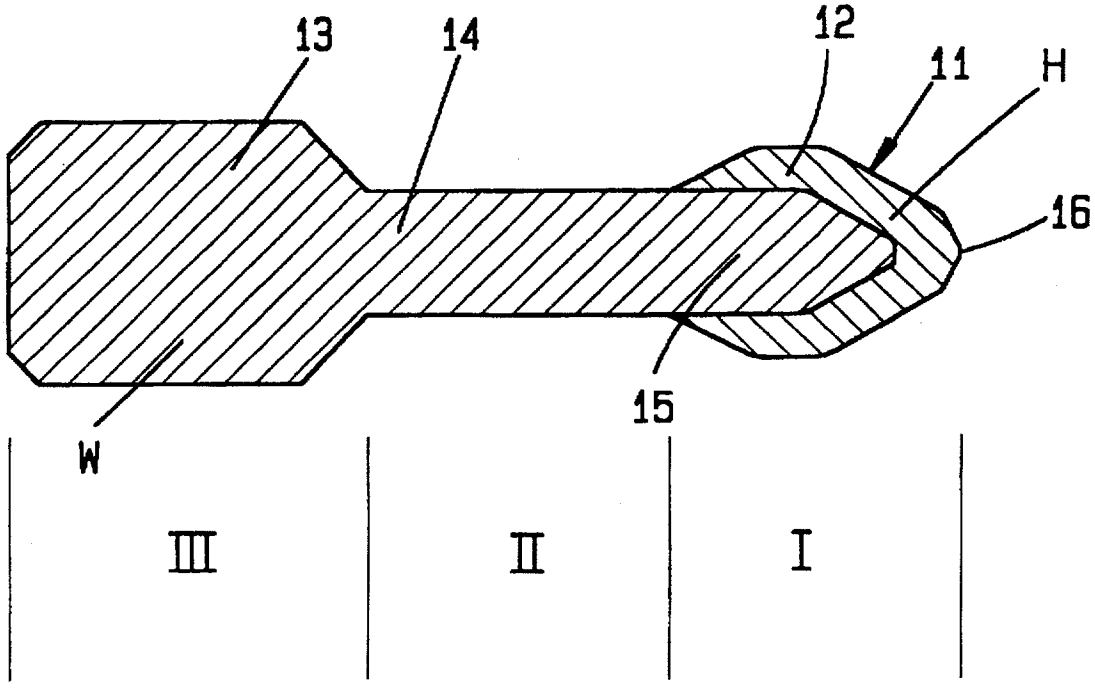


Fig. 3

Fig. 4



TORQUE-TRANSMITTING TOOL

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to a tool, in particular a torque-transmitting tool, preferably a screwdriver or a screwdriver bit, having a shaft and a working region, and to a process for the manufacture of such tools.

A screwdriver bit of this type is known, for instance, from European Patent Application 0 336 136. In the screwdriver bit disclosed there, a twistable zone is provided in its shaft region. This twistable intermediate section represents an elastically yieldable element with corresponding return movement after overcoming the peak load. It endures large torques even upon repeated loading. The intermediate section acts as damper so that torque peaks do not act in directly proportional manner on the screwdriver tip section. In particular, if screws are to be driven by machine into metal thread with such screwdriver bits, considerable torque peaks occur when they are applied since the speed of rotation of the drive motor must drop to zero within a very short period of time. This period of time is lengthened by the elasticity of the torsion sections so that the torque load as a whole is reduced. With regard to the further advantages of such a torsion section, reference is had to Federal Republic of Germany 38 07 972. In the screwdriver bits disclosed there, the torsion zone in a tool the material of which has uniform properties is formed by a special geometrical development of this region of the shaft. This is essentially done by weakening the cross section in this region.

SUMMARY OF THE INVENTION

The object of the invention is to develop the damping region further in an advantageous manner in a tool of this type.

As a result of the invention, a tool is obtained in which the different twistability or hardness or strength of material of tip and shaft section is not necessarily obtained by the shaping of the tool but, rather, by different specific properties of the material of which the tool is made. In accordance with the invention, the damping region has a material which has a lower hardness or, what is the same thing, a lower strength of material. However, it is also provided that this damping region may have a lower torsion-bar constant than the working region. It is, finally, also provided that the damping region which is provided on the shaft has both a lower torsion-bar constant and a lower strength of material. While the working region, which in the case of a screwdriver bit consists of the tip of the screwdriver, is made of a material which has a torsion-bar constant or high hardness, the twistable shaft section is made of a material which has a lower torsion-bar constant or a low torsion spring constant. If the damping region consists of a material which is softer than the working region and therefore is of lesser strength, it can also be provided that the modulus of elasticity in the two sections of the shaft is identical or practically identical. The zone of softer material or lesser strength is then, to be sure, more plastically deformable than the working region. Upon a sudden stopping of the screwing tool, the energy of rotation of the screwing tool can thus flow into the plastic deformation of the section of the shaft. The hardness of this damping region is preferably reduced to such an extent that a plastic deformation of 30° to 60° is possible without the tool breaking. Particularly in the case of small angles of plastic deformation of 30°, it is provided that, after a positive elastic restoration by a few degrees, plastic deformations of

larger amounts are again possible without the screwing tool breaking. If, in accordance with a preferred embodiment, the shaft regions have different moduli of elasticity, then an undesired twistability of the working region is avoided but the desired twistability (elasticity) of the shaft section of the damping region is obtained.

In accordance with the preferred further development, the shaft section has a material of lesser hardness than the working region. By this measure, different deformabilities of the two regions are obtained. The hardness (Rockwell) of the shaft section is preferably up to one quarter less than the hardness of the working region. In this connection, the shaft section is preferably directly adjacent the working region. In other words, in the case of a screwdriver bit, the tip directly adjoins a plastically deformable section of the shaft, which can then pass, for instance, into a driving region which is of polygonal cross section and can also, again, consist of a harder material. The section of the shaft which has the lesser strength can be developed by subsequent annealing (heating) of a preheated tool. The tool can then be made of a single material.

In another preferred development of the tool, the tool consists of two different sintered materials, preferably steels, the working region consisting of a harder material and the shaft section of a softer material. The softer material of the shaft section can in this case also continue into the working region and form a core region there which is, so to speak, sheathed by a harder sintered material. This sheathing forms in the working tip of the tool. By this measure, a continuous transition of the strength from shaft section to working region is obtained. The two sintered materials can differ in this connection in their particle size or in the composition of their material. It is essential however that, in sintered condition, and thus also in the final tool, they form zones of different spring characteristic. In this tool of sintered metal, it is particularly provided that one shaft section is made of a material having a lower modulus of elasticity, so that a lowered torsion-bar constant is obtained here.

In accordance with the method of manufacture, it provided that in the prehardened tool at least one shaft region of the shaft is annealed at a temperature at which a softening of the material, which preferably consists of steel or steel alloy, takes place. In this connection, the working region is cooled in order to retain its physical properties. The annealing is effected in such a manner that the heated section of the shaft is imparted a blue color. By this annealing, the shaft section is preferably heated up into the region of the core and then receives throughout a different structure of material, of a lower strength. Due to the temperature gradient towards the cooled region which is produced upon the annealing, a continuous transition in strength is obtained. Due to the penetration of heat from the surface, the temperature reached in the region of the core can be less than the temperature on the surface, which is considered advantageous with respect to a continuous transition in hardness. The heating is effected preferably by inductive heating. In this connection, the tool is held with the section of the shaft to be heated within an induction coil. The regions of the tool adjoining the shaft section on both sides are preferably cooled by the action of a liquid so that only the intermediate section experiences the desired softening of the material. The action of the liquid can consist in each case of a water shower.

The process for the production of a sintered tool provides that, first of all, a blank forming the shaft is preformed from softer sintered material, on which then the working region of harder material is formed. This blank which consists of two components, is then acted on by heat in order to strengthen

it in known manner. The blank can be injection molded and consist of globular sintered material having a particle size of 10–15 μm. As binder, a resin can be added to the metal powder. Upon the injection molding the process known from the field of plastics can be employed. During the sintering process, the heating of the workpiece in a furnace to the required sintering temperature of, for instance, 1200° Celsius, the binder escapes from the blank. By the additional action of pressure, compacting of the workpiece takes place, and possibly also shrinkage.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a machine screwdriver bit in accordance with a first embodiment;

FIG. 2 shows the variation in hardness of a tool in accordance with FIG. 1;

FIG. 3 is a diagrammatic showing of a tool in accordance with FIG. 1 in the manufacturing process; and

FIG. 4 is a cross section through the tool of the second embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The tools shown in FIGS. 1–4 are screwdriver bits in accordance with the DIN Standard. They have a drive end which is hexagonal in cross section and a shaft section which is of round cross section, as well as a working tip which is X-shaped in cross section and is suitable for engagement into a Phillips screw. With respect to the further features of the development of the embodiments, and in particular the dimensioning of the individual regions, reference is had to European Patent Application 0 336 136. The material of the tool of the invention has a non-homogeneous spring characteristic in its lengthwise direction (axis).

In the first embodiment (FIG. 1), the tool consists of a hardened steel body made of a single material, the shaft region 4 of which has subsequently been changed in its hardness or strength by the action of heat. The working region 2 and the drive region 3, on the other hand, have not been changed in their hardness or strength. The variation in strength of the screwdriver bit 1 shown in FIG. 1, is shown, measured in degrees of hardness, in FIG. 2. It can be noted, in particular, therein that the working region I, which is formed by the insertion tip 2 of X-shaped cross section, has a greater hardness or strength than the shaft section II, which is formed by the substantially cylindrical shaft 4. The diameter of the shaft 4 in the embodiment shown is less than the greatest cross-sectional dimension of the X-shaped working tip 2. The drive region III, which is formed by a cylinder 3 of hexagonal cross section and the diameter of which is greater than that of the shaft 4, has the hardness or strength of the working region I, which is greater than the hardness or strength of the shaft section II.

The transition of hardness from the working region I into the shaft section II as well as the transition in hardness from the drive section III into the shaft section II is not sudden but continuous.

FIG. 3 diagrammatically shows the process for the manufacture of a screwdriver bit of the first embodiment. In order to change the texture of the material of the shaft section II in such a manner than its spring characteristic becomes smaller, this shaft section II is acted on by heat. For this purpose, the shaft section 4 is introduced into an induction coil 5, which is then acted on by current. Due to the formation of eddy current in the shaft 4, heat is produced therein, it effecting the change in texture. The heating is preferably continued until the surface of the shaft has assumed a blue color. In order that the texture of the material of the working tip 2 and of the drive region 3 does not change, the tip 2 and the hexagonal section 3 are acted on by a cooling liquid K. This can take place in the manner of a shower of water.

After such a treatment of the tool, a strength of 63 HRC (Rockwell hardness) is measured on the work tip and a strength of 45 HRC (Rockwell hardness) on the shaft 4. The shaft of a tool which has been treated in this manner can be turned more strongly than the hardened tip 2 or the hexagon section 3 permits, plastic deformation taking place with the stronger rotation, which deformation, depending on the reduction of the strength, can amount to 30° to 60°. The zone can in this connection be plastically deformed not only once but several times without the value of a maximum torque at which the plastic deformation starts changing substantially. If a screwdriver bit manufactured in this manner is acted on by increasing torque, there is initially an elastic deformation of the tool. After a limit torque has been exceeded, plastic deformation takes place. After termination of the plastic deformation, the turned tool moves back only by the amount of the elastic angle.

The screwdriver bit shown in FIG. 4 consists of a tip of X-shaped cross section which forms the working region I, and of a shaft 14, substantially of cylindrical shape, which forms the shaft section II, as well as a hexagonal section which forms the drive region III. The shaft 4 in this connection has a smaller diameter than the maximum diameter of the hexagonal section 13 and of the working tip 12 of the screwdriver bit 11. The screwdriver bit 11 consists essentially of a core of a softer sintered material W and a sheathing of harder sintered material H forming the working tip 12.

Hexagonal region 13 and shaft 14 in this embodiment consist of the softer sintered material W and therefore have a lower torsion-bar constant than the tip 12. In order to obtain a continuous transition in hardness or transition in spring constant, the core region 15 of the working tip 12 is formed of softer sintered material W. The actual working tip itself, on the other hand, is made of harder sintered material H which extends as a sheath over the core. One particular advantage of the manufacture of the tool from sintered materials is that the individual regions of the shaft can be made of different materials or different compositions of material. In this connection, it is even possible to impart different moduli of elasticity to the individual regions of the shaft. In that way, not only is it possible to influence the course of the hardness or of the strength, but the specific strength constant can also be adjusted over the length of the tool.

For the production of such a screwdriver bit 11, a blank forming the hexagonal section 13 and the shaft 14 as well as the core 15 is first of all pre-molded (injection molded) from soft sintered material W. The tip 12 consisting of harder sintered material H is then formed (injection molded) on this blank, the tip having substantially an X-shaped cross section. This blank which consists of two components, is then hardened in known manner by the action of heat. The different sintered materials W and H can differ in their composition and their particle size. A particle size of 10 to 15 micrometers is preferably selected for the harder region. In addition to metallic components, the sinter powder can also contain plastic components as binder. In the final screwdriver bit, the shaft 14 has a greater twistability or strength than the X-shaped working tip 12. The hardness of

the working tip **12** can, in this connection, lie within the range of 60 to 63 HRC and the hardness of the shaft **14** can amount to about 50 HRC.

For the shaping, a process in accordance with German Patent 39 07 022 can be used.

A powdered-metal injection molding process is suitable for the production by powder metallurgy of small parts. The process is derived from the known plastic injection molding in which 50–70 per cent by volume of metal powder is admixed with the plastic. The flowable mass resulting therefrom is compressed to form so-called green compacts. Before the actual injection molding of the metal powder, the metal powder is mixed with a binder which contains plastic components, in a given volumetric ratio of, for instance, 70:30, with reduced pressure of inert gas and a temperature of about 150°–180° Celsius. The volumetric ratio is determined in this connection via the particle size. In the injection molding machine the material is injected slowly into a mold at 150°–200° C. and a pressure of 150 bar. In this connection, the different components can be entered, either simultaneously (multi-component injection molding) or in succession, into different molds or the same molds. The binder can be removed in two steps. In a first step, the green compacts can be dipped into a solvent, whereby a part of the binder is removed so that a sponge-like open porosity is produced which extends through the entire part. Thereupon, the second removal of binder can take place in the sintering furnace together with the actual sintering process. The removal phase lies preferably in the phase in which the furnace is heated up. In this connection, an increased pressure formed by a mixture of argon and hydrogen can be established in the furnace. At the same time as the removal, the powder particles start to sinter together. This takes place at a temperature of about 800° Celsius. A mechanically stable sintered body is then already present. The furnace is then increased to the sintering temperature of about 1200° Celsius and evacuated. When the initially open porosity has closed completely, the pressure in the furnace can be increased up to 100 bar in order to obtain complete compacting of the part. As powder material, globular particles of a particle size of 10–15 μm are used. The chemical composition (alloying) is selected in accordance with the intended hardness (spring characteristic) of the material. Upon the injection molding of the green compacts, a mold having a plurality of mold cavities can be used.

We claim:

1. A torque-transmitting tool, comprising a shaft having a first end and a second end, and a working region supported by the shaft at one of said shaft ends, wherein the shaft has at least one shaft section between said first end and said second end of lower hardness than the working region; and

wherein said hardness of said one shaft section varies continuously from maximum values at both of said ends to a minimum value in a central region of said one shaft section, thereby attaining a reduced torsion spring constant; and

said one shaft section comprises a material, at least part of the material being an annealed material, a remainder of the material of the one shaft section extending with uniformity of material into the working region, a hardness of the annealed material being less than a hardness of said remainder of the material.

2. A tool according to claim 1, wherein said at least one shaft section has a lower torsion-bar constant than the working region.

3. A tool according to claim 1, wherein the hardness of the one shaft section measured in Rockwell is up to one-quarter less than the hardness of the working region.

4. A tool according to claim 1, wherein the one shaft section is directly adjacent the working region.

5. A tool according to claim 1, further comprising a drive region, and wherein the one shaft section of lower hardness and lower spring constant is arranged between the drive region and the working region.

6. A tool according to claim 1, wherein the material is steel.

7. A torque-transmitting tool, comprising a shaft having a first end and a second end, and a working supported by the shaft at one of said shaft ends, wherein the shaft has at least one shaft section between said first and said second end of lower hardness than the working region; and

wherein said hardness of said one shaft section varies continuously from maximum values at both of said ends to minimum value in a central region of said one shaft section, thereby attaining a reduced torsion spring constant; and

said working region comprises a first sintered material and said one shaft section comprises a second sintered material different from said first sintered material, the tool further comprising a drive region comprising a material harder than the second sintered material of the one shaft section, the first sintered material of said working region being harder and having a higher modulus of elasticity than the second sintered material of the one shaft section.

8. A tool according to claim 7, further comprising a drive region having a higher torsion-bar constant and hardness than said one shaft section, said drive region adjoining the one shaft section.

9. A tool according to claim 7, wherein in a transition region from the one shaft section to the working region, the first sintered material of the working region constitutes a core of lesser harness and lower modulus of elasticity than an outer portion of the working region.

10. A tool according to claim 7, wherein said one shaft section is subjected to a plastic deformation upon action of a torque which lies above an upper limit torque.

11. A tool according to claim 7, wherein the tool has a plastic deformability which permits at least a single excess turning of the one shaft section by at least 30° relative to the working region without a breakage weakening of the tool.

12. A tool according to claim 7, wherein subsequent to a succession of plastic deformations of the tool, a limit torque at which a plastic deformation takes place within said at least one shaft section remains substantially unchanged after a first of said plastic deformations.

* * * * *

United States Patent [19]

Stehling

[11] **Patent Number: 5,033,501**

[45] **Date of Patent: Jul. 23, 1991**

[54] **FIRE HYDRANT CAP AND ACTUATING TOOL THEREFOR**

[75] Inventor: **Henry Stehling**, Irving, Tex.

[73] Assignee: **Hydra-Shield Manufacturing, Inc.**, Irving, Tex.

[21] Appl. No.: **622,070**

[22] Filed: **Dec. 4, 1990**

[51] **Int. Cl.**[5] **F16K 35/10**; E03B 9/06

[52] **U.S. Cl.** ..... **137/296**; 7/138; 81/125; 81/176.15; 137/381; 137/800; 184/5; 220/85 P; 220/284; 403/19; 411/405; 411/432; 411/911

[58] **Field of Search** ..... 7/138, 166; 81/55, 125, 81/176.1, 176.15, 176.2, 487; 137/296, 371, 377, 381, 382, 382.5, 800; 215/213, 215; 220/85 P, 284; 222/182; 184/5, 100, 105.3; 403/19; 411/405, 429, 432, 910, 911

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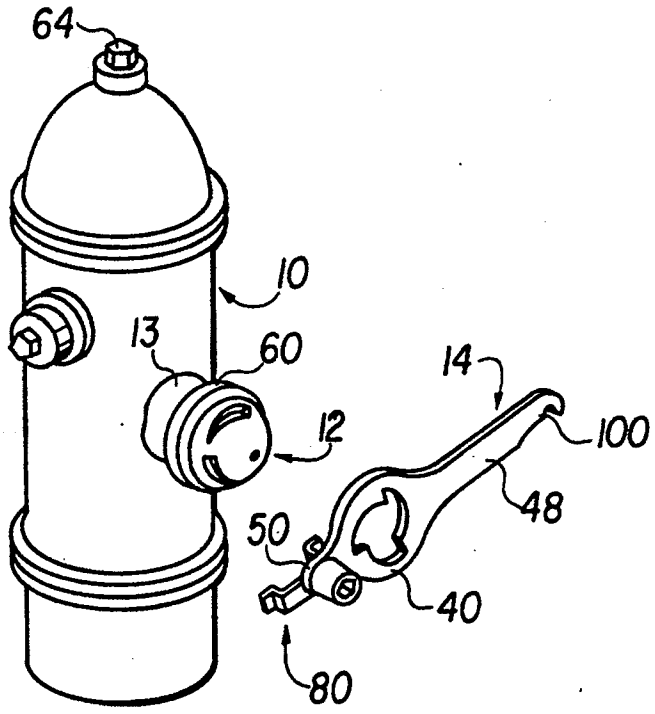
Primary Examiner—George L. Walton
Attorney, Agent, or Firm—Millen, White & Zelano

[57] **ABSTRACT**

A fire hydrant cap and actuating tool for use therewith provide enhanced security for fire hydrants and increased safety when using the tool. The cap is forged of 8620 carbon steel; is provided with an internal steel lock washer of cadmium plate steel, and includes thereon a forged, external slip ring of 8620 carbon steel with lubrication between the slip ring and cap. The tool which is used in combination with the cap includes a gripper which fits under the slip ring to prevent the tool from slipping, a spanner wrench and a hexagonal socket with a screw for gripping rounded-off valve stems.

11 Claims, 4 Drawing Sheets



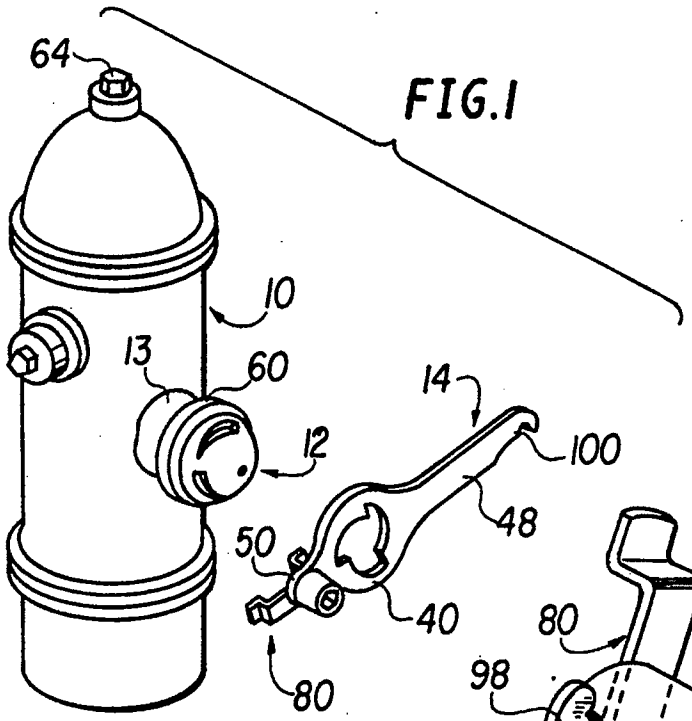

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FIG.1

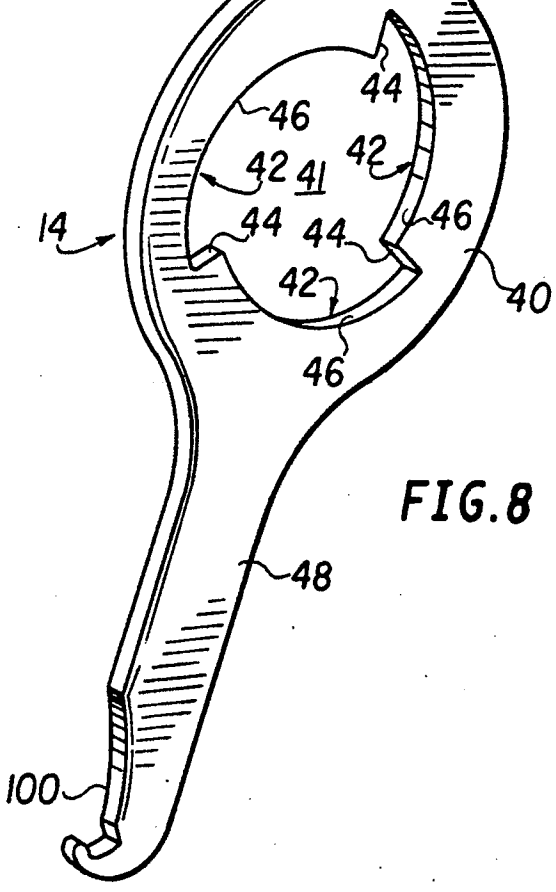
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FIG.8

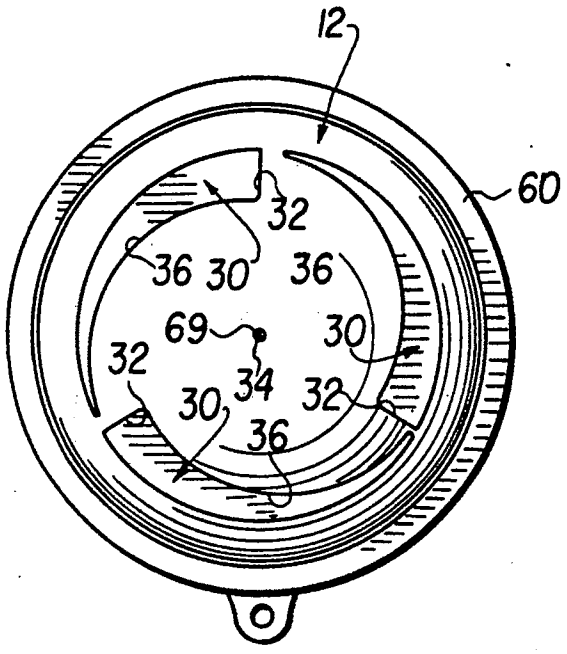

FIG. 2

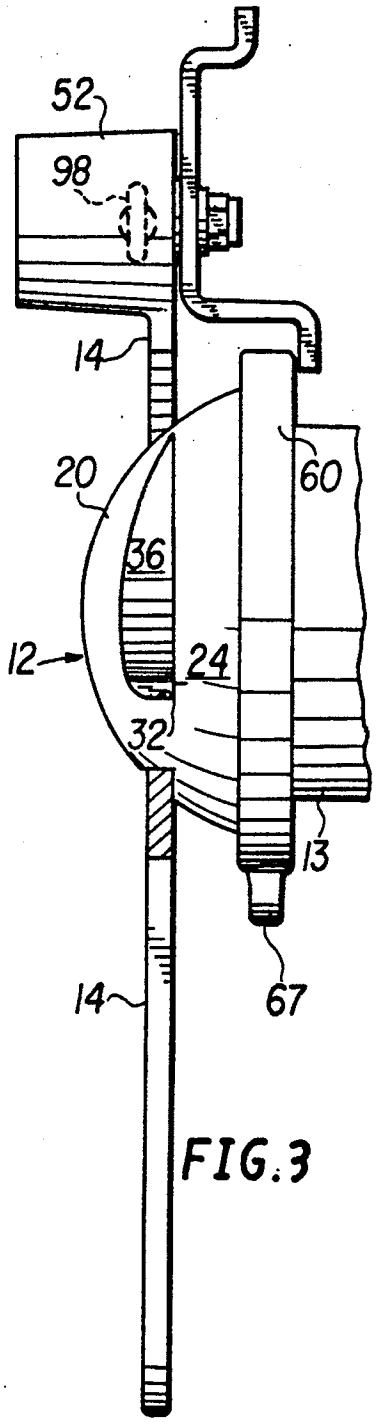

FIG. 3

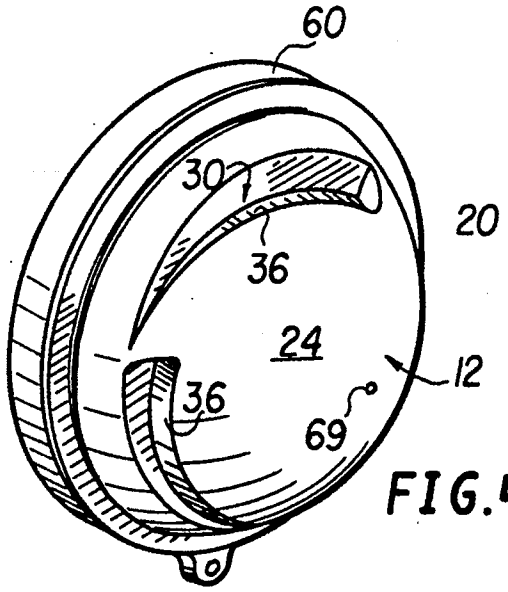

FIG. 4

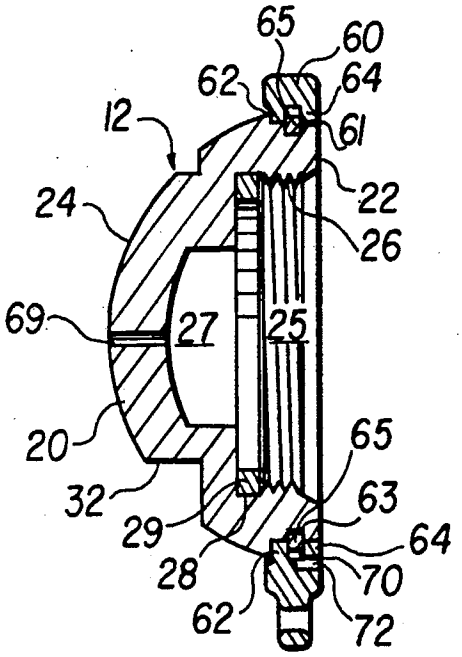

FIG.5

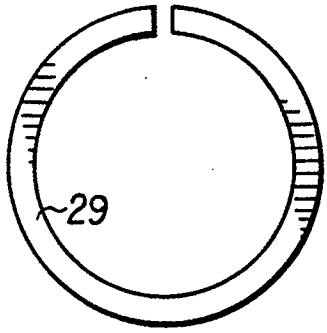

FIG.6

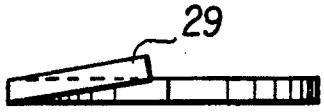

FIG.7

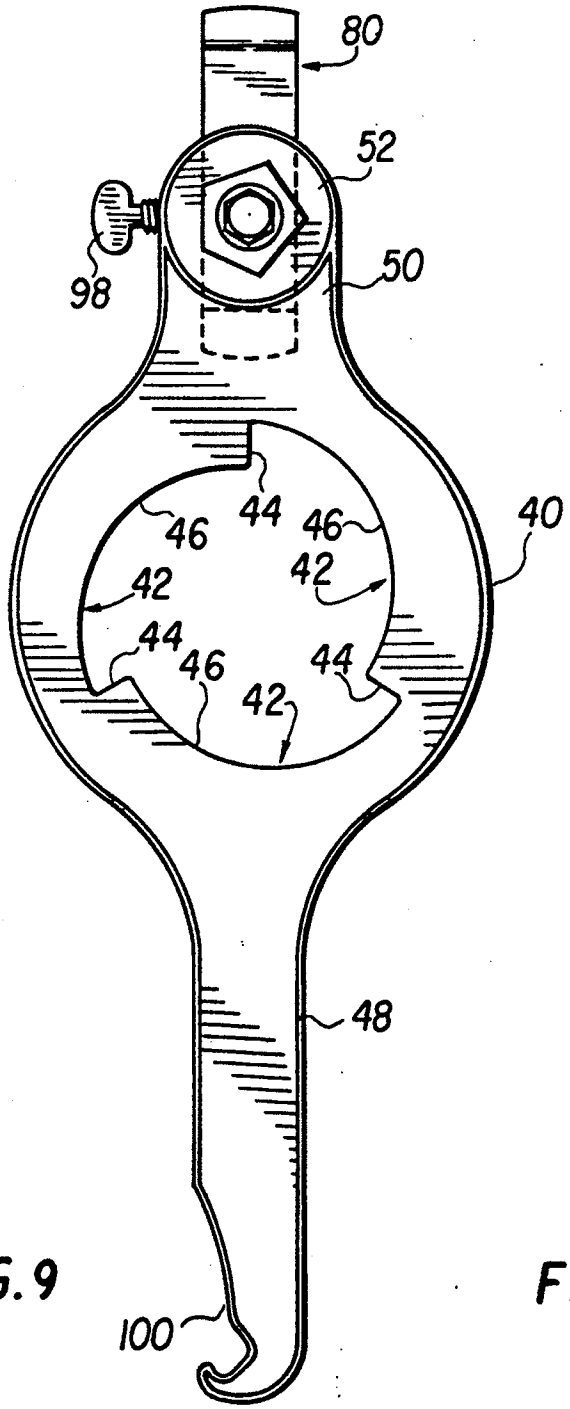
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FIG. 9

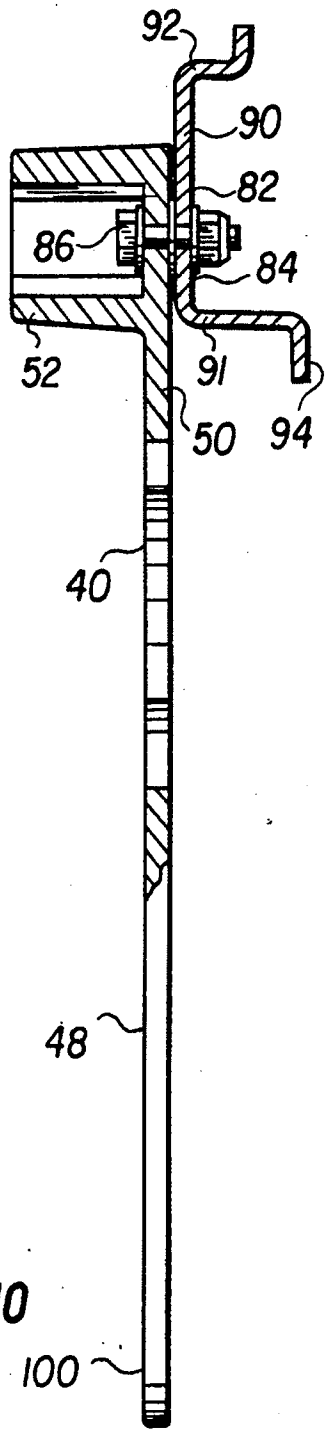
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FIG. 10

FIRE HYDRANT CAP AND ACTUATING TOOL THEREFOR

BACKGROUND OF THE INVENTION

The instant invention relates to fire hydrant caps and actuating tools for use therewith. More particularly, the instant invention relates to fire hydrant caps and actuating tools for use therewith wherein security provided by the caps is enhanced while use of activating tools for the caps is made safer.

In many communities, fresh water has become, or is becoming, a valuable commodity which is metered to its users. A ubiquitous source of fresh water in urban and suburban communities is the enormous number of fire hydrants distributed throughout these communities. In order to protect such communities from fire, these hydrants must be readily available to fire departments. Unfortunately, in many areas, hydrants are opened by residents and others in order to obtain quantities of fresh water, sometimes for recreational purposes and at other times for sale to fresh water users. For example, tanker trucks frequently fill illegally at fire hydrants and sell stolen water to swimming pool owners. From time to time vandals damage, open and waste water from fire hydrants for no rational purpose whatsoever.

In order to protect water supplies and prevent fire hydrants from being opened by people other than those having authority to do so, vandal-proof security arrangements have been developed. For example, U.S. Pat. No. 3,929,152 to Graham discloses a vandal-proof cap which is in wide use throughout the United States. This vandal-proof cap relies upon a steel cap which is threaded on the outlet of a fire hydrant. The steel cap has a dome shaped outer surface with a series of grooves therein which require the use of a special wrench having a gripping portion with shoulders for engaging the grooves. The cap of Graham has been improved over the years by providing a slip ring which minimizes the effectiveness of band-type wrenches or other large wrenches in illegally removing the cap. Unfortunately, vandals are beginning to defeat the Graham device by pounding the slip ring with a sledge hammer to weld the slip ring to the cap so that purchase of the slip ring with the cap enables one to apply sufficient torque to remove the cap with tools other than the specially configured tool provided only to fire departments.

In addition, it has been found that the specially configured tool or wrench utilized to back the cap off can slip from the cap. Since the wrench is large and the torque applied by the wrench is considerable, if the wrench slips there is risk of injury to the firemen using the wrench and to any one standing near the wrench.

In view of the aforementioned considerations, there is need for improvement in the original Graham arrangement.

SUMMARY OF THE INVENTION

It is an object of the instant invention to provide a new and improved fire hydrant cap and actuating tool for use therewith.

In view of this object and other objects, the instant invention comprises an improvement in the fire hydrant cap disclosed in U.S. Pat. No. 3,929,152 by utilizing a cadmium plated, steel lock washer within the cap and a forged carbon steel slip ring around the periphery of the cap.

The invention further contemplates providing lubrication between the slip ring and cap and fabricating both the cap and slip ring as forgings of 8620 carbon steel.

In addition, the instant invention comprises an actuating tool in combination with the cap wherein the actuating tool includes a gripper for seating behind the slip ring in order to minimize the possibility of the actuating tool slipping from the cap when the torque is applied through the tool.

Upon further study of the specification and appended claims, further objects and advantages of this invention will become apparent to those skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other objects, features and attendant advantages of the present invention will be more fully appreciated as the same becomes better understood when considered in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the several views, and wherein:

FIG. **1** is a perspective view, showing the fire hydrant cap of the instant invention in place on a fire hydrant and an actuating tool of the instant invention in position to engage the cap;

FIG. **2** is an enlarged end view of one end of the fire hydrant cap of FIG. **1**;

FIG. **3** is a cross-sectional view taken along line **3**—**3** of FIG. **2** including the actuating tool engaging the cap;

FIG. **4** is a perspective view of the fire hydrant cap of the instant invention:

FIG. **5** is an enlarged cross-section of the cap according to the instant invention;

FIG. **6** is a planar view of the cadmium steel, split ring lock washer used in the cap of FIGS. **1**–**4**;

FIG. **7** is a side view of the lock washer of claim **6**;

FIG. **8** is an enlarged perspective view of the actuating tool of the instant invention;

FIG. **9** is a planar view of the actuating tool of FIG. **6**; and

FIG. **10** is a side view of the actuating tool of FIGS. **7**.

DETAILED DESCRIPTION

Referring now to FIG. **1**, there is shown a fire hydrant, designated generally by the numeral **10**, upon which is threaded a fire hydrant cap, designated generally by the numeral **12**. The cap **12** is threaded on external threads of an outlet **13** by rotating the cap in the clockwise direction with an actuating tool, designated generally by the numeral **14**.

Referring now to FIGS. **2**–**7** in combination with FIG. **1**, it is seen that the fire hydrant cap **12** has a body portion **20** with a planar back surface **22** and a dome-shaped front portion **24** which faces outwardly. The cap **12** is hollow and includes an inner surface, designated generally by the numeral **25**, having a threaded portion **26** and a cavity **27**. Seated within the cavity **27** against an internal annular shoulder **28** is a split steel ring **29** (FIGS. **6** and **7**) which binds with the threaded end of the outlet **13** when the cap **12** is tightened thereon by the wrench **14**.

The dome-shaped surface **24** provides a curved, convex shape which is not readily engageable with conventional tools, such as wrenches having parallel jaws, and

includes no sharp corners or edges which can be engaged by chisels for unthreading the cap. Preferably, the domed surface 24 is in the form of a sector of a sphere, although any curved convex surface may be utilized which cannot be easily gripped by conventional tools and rotated off the fire hydrant outlet 13.

In order to rotate the cap 12 so as to thread onto and off the externally threaded outlet 13 of the fire hydrant 10, a plurality of tool engaging surfaces, generally designated by the reference numerals 30, are positioned on the domed surface 24 of the cap. Each tool engaging surface 30 includes a shoulder 32 facing oppositely to the direction in which the cap is threaded onto the hydrant outlet 13 for providing surfaces engageable by the tool 14. The internal threads 26 within the cavity 25 of the cap 12 are usually threaded for right-hand rotation and thus the shoulders 32 are oriented to face in a counterclockwise direction around the longitudinal axis 34 of the cap 12 to provide surfaces for engagement by an actuating tool used for threading and tightening the cap 12 onto the outlet 13. While the shoulders 32 may be engaged by tools such as chisels and hammers, any force applied to the shoulders 32 will always be in a direction for tightening the cap 12 onto the outlet 13. The shoulders 32 cannot be engaged by any conventional wrench for unthreading the cap 12.

Each of the engaging surfaces 30 also include recesses 34 extending from each shoulder 32 in a direction opposite to the direction in which the cap 12 is threaded onto the hydrant outlet 13. Each recess 34 includes a curved surface 36 extending from the shoulder 32 and progressively increasing in radial distance from the longitudinal axis 34 of the body 20 for providing a surface for coacting with the actuating tool 14. It is emphasized that the curved surfaces 36 do not provide a gripping surface for engagement by any conventional tools for unthreading the cap 12.

As is best seen in FIG. 2, it is preferred to provide three engaging surfaces 30 spaced an equal distance of approximately 120° apart around the domed surface of the cap 12.

Referring now more specifically to FIGS. 1, 3 and 8–10, the actuating tool 14 for threading and unthreading the cap 12 from the hydrant 10 includes a ring portion 40 which is preferably circular. The ring portion 40 includes an internal opening 41 for fitting around the domed surface 24 of the cap 12 and includes a plurality of actuating surfaces, generally indicated by the numeral 42. The number of actuating surfaces 42 are equal to the number of tool engaging surfaces 30 on the cap 12 coacting therewith. Each actuating surface 42 includes a shoulder 44 positioned to coact with one of the shoulders 32 of the cap 12. In addition, each of the actuating surfaces 42 also includes a curved portion 46 which extends from its respective shoulder 44 in a clockwise direction and progressively decreases in distance from the center of the ring portion 40 so as to coact with the curved surfaces 36 on the cap 12. Tool 14 also includes a handle 48 connected to the circular portion 40 for applying torque to the ring 40. At the end of the handle 48 is a hooked portion 49 which is configured as a spanner wrench to cooperate with other structures (not shown) associated with pumper equipment. Extending from the ring portion 40 in a direction opposite the handle 48 is a flange 50 which has a hexagonal socket 52 projecting therefrom which socket cooperates with the hexagonal valve stem 64 (FIG. 1) projecting from the top of the hydrant 10 in order to open the valve (not shown) within the hydrant to let water flow through the outlet 13 when the cap 12 is removed.

In operation, the actuating tool 14 is placed over the domed surface 24 to bring the shoulders 44 on the tool 14 into engagement with the shoulders 32 of the cap 12 so that rotation of the handle 14 in the clockwise direction will tighten the cap 24 onto the hydrant 10. When it is desired to remove the cap 12 from the hydrant 10, the actuating tool 14 is again fitted over the domed surface 24 of the cap 12, placing the curved portions 46 of the tool 14 in engagement with the curved surfaces 36 on the cap so that when the tool is rotated in a counterclockwise direction, the cap is unthreaded from the outlet 13.

A number of features have now been provided to enhance the effectiveness and safety of caps such as the cap 12 and actuating tools such as the actuating tool 14. Referring now more specifically to FIGS. 5–7, in order to minimize the ability of an unauthorized person or vandal to unthread the cap 12 from the outlet 13, a slip ring 60 has been placed around the cap 12 adjacent the rear surface 22 thereof. If an attempt is made to grip the cap 12 with a band wrench or similar device where the curvature of the cap approaches the cylindrical surface of the outlet 13, slip ring 60 rotates with respect to the cap. In order to discourage vandals from welding the slip ring 60 to the surface of the dome shaped portion 24 by pounding the slip ring 60 with a sledge hammer or by jamming a wedge between the slip ring 60 and the surface 24, slip ring 60 is made of 8620 carbon steel as is the cap 12. The 8620 carbon steel of the slip ring and cap 12 are normalized at 1750° F. and drawn at 1150° F. and are then heat treated and carburized to a Rockwell "C" hardness in the range of 58–62 RC to a depth of 0.030".

To facilitate assembly, the slip ring 60 has an inner diameter equal to the outer diameter of a reduced diameter portion 61 of the cap 12. The domed portion 24 of the cap 12 ends abruptly with a shoulder 62 which extends inwardly to the reduced diameter portion 61 and is abutted by the slip ring 60 when the slip ring is slid over the reduced diameter portion 61 of the cap. An annular groove 63 is formed in the reduced diameter portion 61 of the cap 12 which groove is opposed by a complementary annular groove 64 in the slip ring 60. A split snap ring 65 of spring steel is received in both the grooves 63 and 64 to retain the slip ring 60 on the cap by preventing the slip ring from dislarging off the back end 22 of the cap. During assembly, the split snap ring 65 is spread into the groove 64 of the slip ring 60 so that the assembly of the slip ring and snap ring clears the reduced diameter portion 61 of the cap.

Unitary with the slip ring 60 is a hookeye 67 having an opening 68 therethrough for receiving a safety chain (not shown) so that the cap 12 can remain loosely attached to the fire hydrant 10 after the cap is unthreaded from the outlet 13.

The improved cap 12 includes a weep hold 69 connecting the cavity 27 to the atmosphere so as to equalize pressure between the atmosphere and the inside of the hydrant 10.

A space 70 is provided between the slip ring 60 and adjoining portions of the cap 12 to accommodate lubrication so that the ring will slip easily with respect to the cap. Access to the lubrication space 70 is provided by a bore 72 positioned behind hook eye lug 69 so that additional lubrication can be added from time to time to maintain slippage between the ring 60 and cap 12. An appropriate lubricant is #1242 lithium base grease. The

lubricant works its way around the snap ring **65** and through the split in the snap ring so that the grooves **63** and **64** retain the lubricant. The resulting arrangement enhances the vandal resistance of the cap and prevents hard water corrosion buildup from locking the ring **60** to the cap. Moreover, lubrication provides for proper operation of the slip ring **60** over a longer period of time while the bore **72** allows the ring to be lubricated on site.

The split ring **29** shown in FIGS. **5–6** is a double zinc or cadmium-plated, steel lock washer which does not deteriorate over time (which was a problem with the previously used rubber washers). In addition, the steel lock washer **29** requires 150–160 foot pounds of torque to rotate the cap **12** with respect to the outlet **13**, whereas the previously used rubber washer required only about 75 foot pounds. As is seen in FIG. **7**, the lock washer **29** is offset approximately one thickness so as to apply pressure to the face of the outlet **13** of the fire hydrant **10**.

The increased amount of torque necessary to dislodge the cap **12** from the outlet **13** increases the possibility for the wrench or actuating tool **14** slipping from the cap when attempting to remove the cap. In order to minimize this possibility, a gripping element, designated generally by the numeral **80** is pivoted on the handle **14**. Preferably, the gripping element **80** is retained on the flange **50** by a bolt **82** passing through a hole **84** in the base of the hexagonal socket **52** (see FIG. **8**). The bolt **82** has a nut **86** rotationally fixed with respect thereto so that the gripper **80** is freely rotatable on the bolt **82**. The gripping element **80** has a generally U-shaped portion **90** with a long leg **91** and a short leg **92**. Secured to the long leg **91** is a first flange **94** which, as seen in FIG. **3**, fits behind the slip ring **60** and prevents the actuating tool **14** from slipping from the cap **12**. The long leg **91** and first flange **94** are used for engaging caps **12** on four and one half inch outlets **13**. The sort leg **92** has a second flange **96** projecting therefrom for engaging the caps **12** on two and one half inch outlets **13**. It is emphasized that the gripper **80** is freely rotatable on the bolt **82** so as to readily seat behind the slip ring **60**.

From time-to-time vandals attempt to rotate the exposed valve stem **64** (FIG. **1**). After a while, the valve stem **64** can become rounded off so that the hexagonal socket **52** slips. In order to avoid slippage in such situations, the socket **52** is provided with a thumb screw **98** threaded through the wall of the socket **52** for tightening against the hexagonal nut **64** so as to achieve purchase when the nut is rounded off.

The free end of the handle **48** of activating tool **14** includes a spanner wrench portion **100** which can be used to tighten or remove rocker lugs, pin lugs, slotted hose couplings and hydrant caps (structures not shown). Thus, the actuating tool **14** negates the need for firemen to carry separate spanner wrenches for these purposes.

In addition to the gripping element **80**, the tool **14** has an increased cross-sectional area in the vicinity of the hexagonal socket **52** and well as an increased wall thickness for the socket and an increase radius area in the handle **48**. Moreover, the actuating tool **14** is made of a higher grade ductile iron ASTM A536 65-45-12 as cast, having a BHN hardness in the range of 217 to 235.

All patents, publications and standards cited herein are hereby incorporated by reference.

From the foregoing description, one skilled in the art can easily ascertain the essential characteristics of this invention, and without departing from the spirit and scope thereof, can make various changes and modifications of the invention to adapt it to various usages and conditions.

What is claimed:

1. A fire hydrant cap for a fire hydrant outlet being mounted to an removed from said hydrant outlet by a specialized tool, said cap comprising:

a body having a domed surface formed of a carbon steel forging and heat treated to a Rockwell "C" hardness at least in the range of 50–62, the body having an internal surface and external surface;

the internal surface of the body having internal threads extending inwardly into the body for attachment to said fire hydrant outlet, the internal surface also including an annular shoulder therein;

a cadmium plated steel lock washer in the form of a split ring seated against the internal shoulder;

the external surface extending around and over the internal surface and having a curved, convex shape;

a plurality of tool engaging surfaces disposed thereon and spaced from each other and positioned on the external surface, each tool engaging surface including a shoulder facing oppositely to the direction in which the cap is threaded onto said hydrant outlet for providing shoulders for engagement by a tool having .complementary surfaces for cooperative engagement with said tool engaging surfaces for tightening said cap to said hydrant outlet when torque is applied to said tool;

each engaging surface including a recess extending from the shoulder in a direction opposite the direction in which the cap is threaded onto the hydrant, each of the recesses including a curved surface progressively increasing in distance from the axis of the body and including a side wall which extends parallel to the longitudinal axis of the cap for coacting with said tool complementary surfaces for unthreading the cap from said hydrant outlet;

an externally facing annular groove in the external surface adjacent a portion of the cap where the external and internal surfaces meet;

a slip ring forged of carbon steel and having an internally facing annular groove in alignment with the externally facing annular groove in the external surface of the cap, said slip ring having a back surface for engaging a selective gripping means disposed on said tool; and

a spring steel snap ring in registration with both grooves to secure the slip ring on the cap in rotational relation therewith, and said selective gripping means cooperating with slip rings of different size caps mounted on said hydrant outlet to prevent said tool complementary surfaces from slipping off of said tool engaging surfaces when torque is applied to said tool for tightening and removal of said cap to and from said hydrant outlet.

2. The cap of claim **1**, wherein space is provided between the slip ring and the cap for receiving a lubricant to facilitate slippage of the ring with respect to the cap.

3. The cap of claim **2**, further including a bore in the slip ring, the bore communicating with the space between the cap and slip ring wherein lubricant can be introduced after the cap and slip ring are assembled.

4. The cap of claim **3**, wherein the cap and slip ring are both forgings of 8620 carbon steel.

5. The cap of claim 1, further including in combination therewith an actuating tool, the actuating tool comprising:

a ring portion defining an internal opening and a handle extending from the ring portion for rotating the tool;

the ring portion including a plurality of actuating surfaces positioned about the internal opening for coacting with the engaging surfaces on the exterior surface of the cap for tightening and untightening the cap from a hydrant, each actuating surface including a shoulder positioned and shaped to coact with a shoulder on the cap engaging surfaces and including a curved portion positioned and shaped to coact with the curved surface on the cap engaging surface on the exterior surface of the cap;

said gripping means includes a gripper attached in proximity to the ring portion, the gripper having a portion thereon for underlying the slip ring on the cap when the tool is placed over the cap to prevent the tool from slipping from the cap.

6. The combination of claim 5, wherein the gripper is movably mounted on the handle so that the portion underlying the slip ring may be moved into operative position after the handle is placed on the cap.

7. The combination of claim 6, wherein the gripper is pivoted on the handle for rotation to operative position.

8. The combination of claim 7, wherein the actuating tool includes a hexagonal socket for opening fire hydrant valve stems, the hexagonal socket projecting from the ring portion at a location opposite that of the handle with the gripper projecting in a direction opposite that of the socket.

9. The combination of claim 8, wherein the socket includes a bolt projecting therefrom on which the gripper is freely rotatable.

10. The combination of claim 8, wherein the socket is defined by a wall and wherein the socket further includes a threaded bore through the wall thereof and a screw threaded in the bore, wherein upon tightening the screw, the socket can achieve purchase on a rounded off valve stem.

11. The combination of claim 10, wherein the handle has a free end portion and includes a spanner wrench at the free end portion thereof.

* * * * *

US005295831A

United States Patent [19]

Patterson et al.

[11] Patent Number: 5,295,831

[45] Date of Patent: Mar. 22, 1994

[54] DISPOSABLE TORQUE WRENCH FOR DENTAL COMPONENTS

[75] Inventors: **Chad J. Patterson**, Plantation; **Richard A. Smolowitz**; **Bruce L. Nickerson**, both of Davie, all of Fla.

[73] Assignee: **Impla-Med, Inc.**, Sunrise, Fla.

[21] Appl. No.: **946,924**

[22] Filed: **Sep. 17, 1992**

[51] **Int. Cl.**[5] **A61C 3/00**; A61C 8/00; B25B 23/153

[52] **U.S. Cl.** **433/141**; 81/471; 433/173

[58] **Field of Search** 433/141, 163, 173, 174; 81/436, 467, 471

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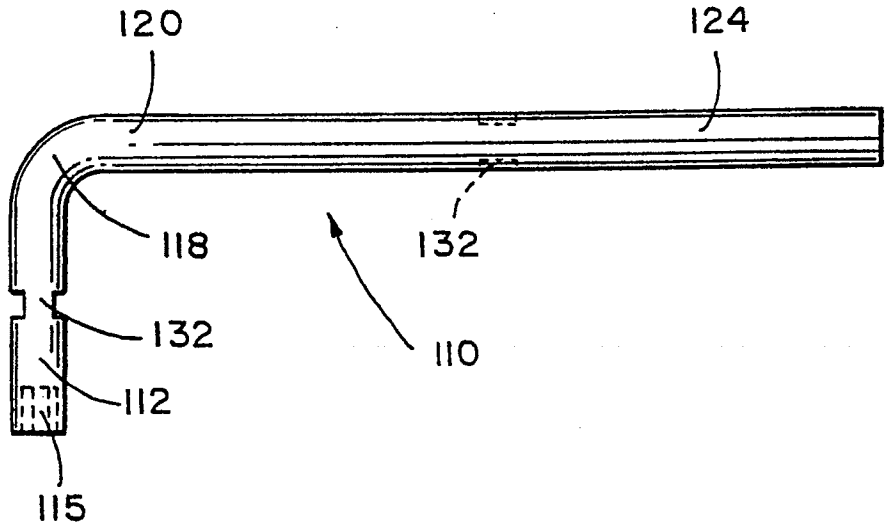
Primary Examiner—John J. Wilson
Assistant Examiner—Nicholas D. Lucchesi
Attorney, Agent, or Firm—David P. Gordon

[57] **ABSTRACT**

A torque wrench particularly suited for applying a selected maximum torque to a dental implant component is constructed of a single shaft of predetermined material and dimension with an undercut or relieved portion therein such that application of a predetermined torque to the dental component through the shaft produces a deformity in the shaft at the relief. The shaft is designed with one end to engage the implant component or device coupled thereto. Where the shaft is straight, the other end of the shaft is designed to engage a driver. Alternatively, the shaft is bent by ninety degrees so that the other end of the shaft acts as an integral lever arm. Preferably, the undercut in the shaft is diamond shaped such that it increases in width as it increases in depth and then decreases in width as it decreases in depth. The diamond shaped undercut reduces the likelihood that upon deformation the shaft will break and produce jagged edges and metal fragments.

20 Claims, 2 Drawing Sheets



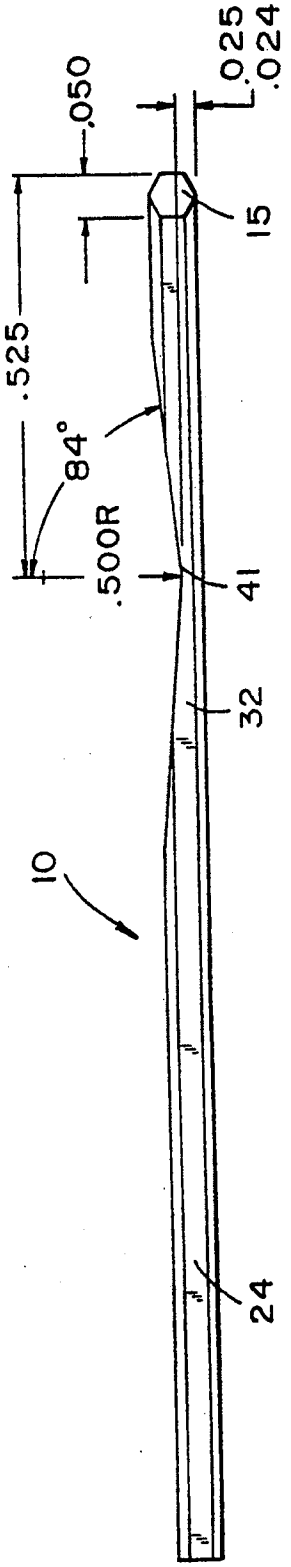

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FIG. 1a

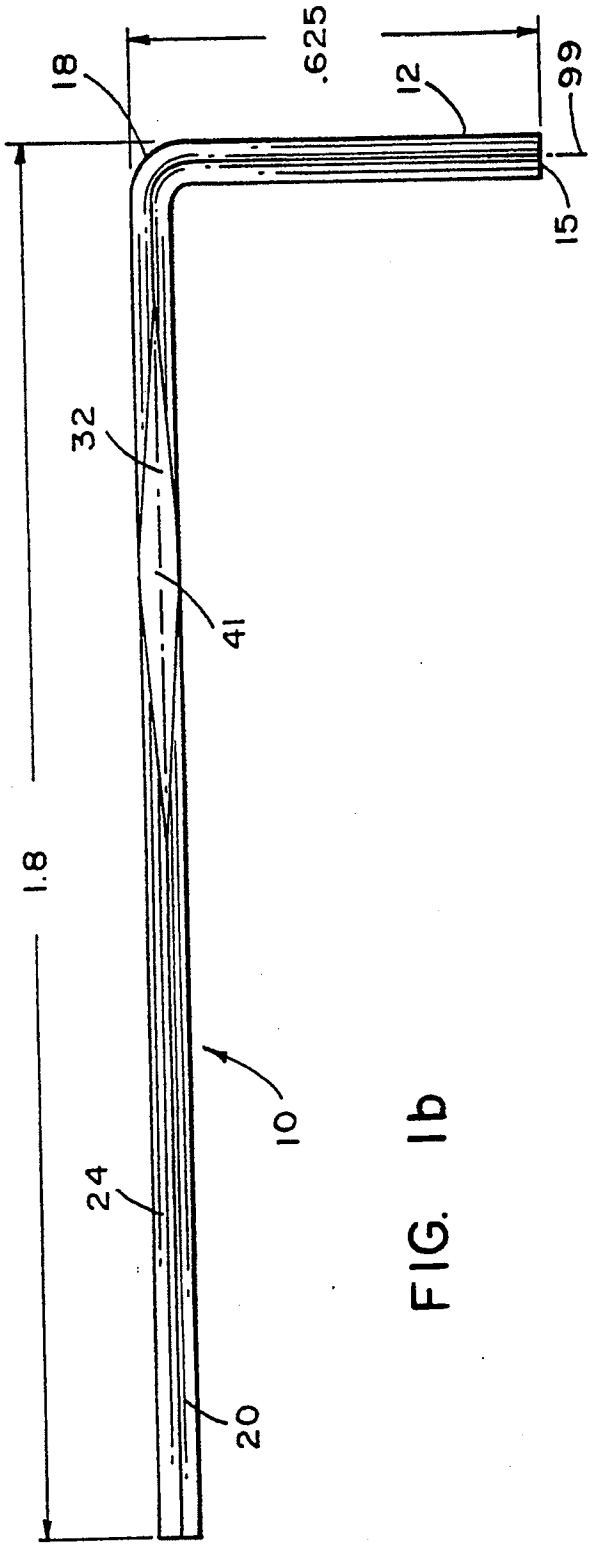
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FIG. 1b

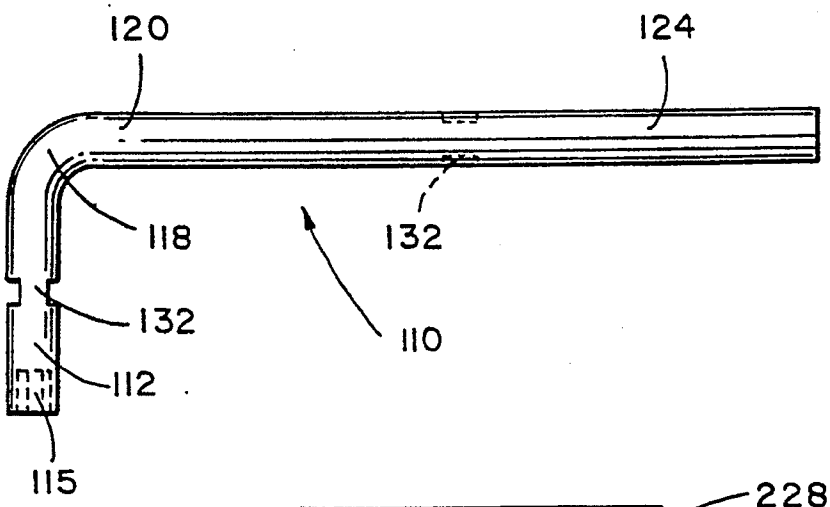

FIG. 2

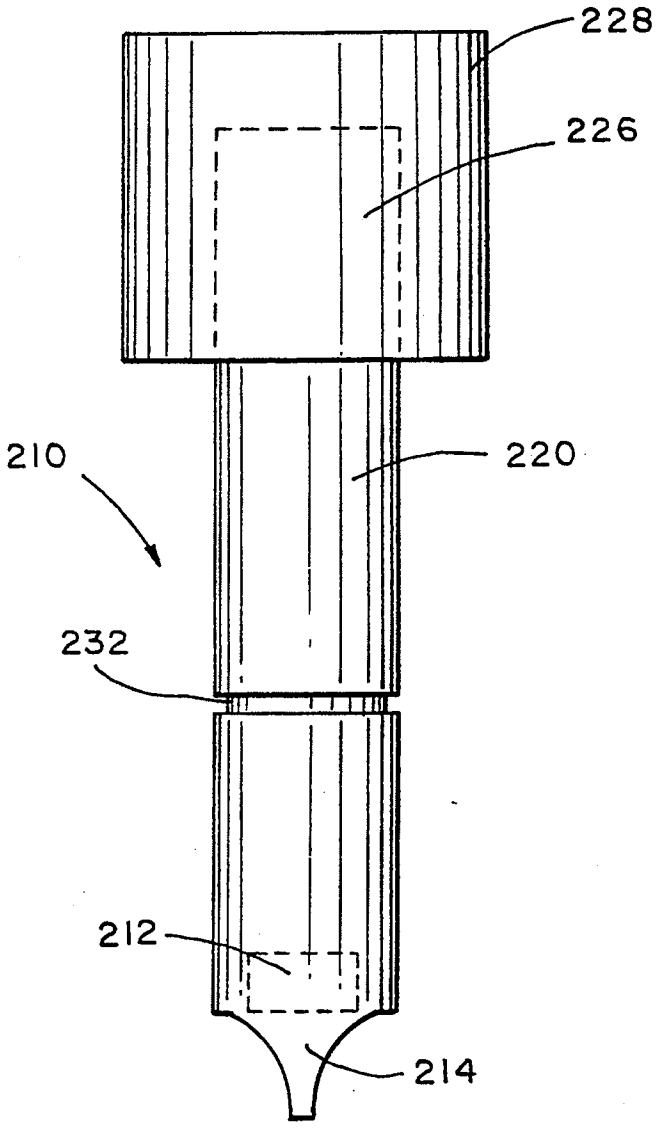

FIG. 3

DISPOSABLE TORQUE WRENCH FOR DENTAL COMPONENTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to torque wrenches for dental components. More particularly, the invention relates which to a disposable torque wrench for applying a selected maximum torque during installation of a prosthetic component onto a dental implant.

2. State of the Art

Torque wrenches are known to be useful in medicine and dentistry. For example, U.S. Pat. No. 4,304,445 to Bailey et al. discloses a "Dental Wrench" having a structure which permits application of differing torques to the bur securing collet of a dental handpiece and the end cap of a turbine housing in a single wrench assembly. The Bailey et al. wrench has a shaft which engages the bur securing collet, and which is supported rotatively in a frame member and secured to a support member which has means for engaging the end cap of the turbine housing. Interlocking means are provided between the support member and the frame member so that the wrench can be rotated as a unitary assembly to secure or remove the end cap of a turbine housing. The interlocking means are releasable so that the shaft can be rotated independently within the frame member to secure or remove a dental bur in or from the collet of the handpiece housing. That portion of the frame member which is gripped for securing the end cap of the housing is of larger diameter relative to the support member so that increased torque can be applied to the end cap when the interlocking means is engaged to securely fasten the cap to the housing.

Another dental torque wrench with a similar purpose is disclosed in U.S. Pat. No. 3,935,761 to Junkel et al. The torque wrench of Junkel et al. includes a unitary angular C-shaped body, one of the arms of the body being provided with a socket, and a recess for accurately locating the wrench in position relative to the head of a handpiece when chuck adjustment (or removal) is desired. Between the paired arms is a knurled cylindrical wheel dimensioned to fit comfortably between, and be rotated by, the same fingers that receive the narrower connecting portion of the C-shaped body. A torsion spring shaft extends through the wheel and into the socket and has a non-circular end portion receivable with in opening of a handpiece chuck for locking the two parts (chuck and shaft) against independent relative rotation. A shoulder of the shaft limits the extent that the end portion may be inserted into the chuck opening, and the substantial length of that shaft, and its relationship with the other parts of the wrench, result in a torsional flexure of the shaft upon chuck tightening that signals the user when the torque limit is approached. The shaft is spring-loaded for limited axial movement.

In addition to torque wrenches designed for adjusting dental tools, there are known torque wrenches for applying torque to dental implants, posts and other components. For example, U.S. Pat. No. 4,480,997 (reissue 31948) to Deutsch et al. discloses a "Dental Post and Wrench Therefor and Method of Restoring Bulk to a Tooth Root Therewith". This known wrench is used to apply a predetermined torque to a dental post to thread it into the tooth root for crown restoration. The wrench is small and designed to be manipulated with thumb and index finger. It has a manually rotatable driving handle, the interior of which is hollowed to form a chamber. The lower end of the chamber terminates in a closure wall that has a centrally located opening through which a driven shaft extends outwardly from the handle. The driven shaft has an enlarged head, the undersurface of which provides a clutch or engaging surface that engages with the facing engaging surface of the closure wall. The engaging surfaces of the head and the closure wall function as clutch means to transmit the drive from the drive handle to the driven shaft.

The known torque wrenches for use in dentistry are relatively complex and expensive, difficult to calibrate, and require repeated sterilizations. They all require either a clutch means, a spring loading, or interacting parts movable relative to each other. For the purpose of applying a maximum torque to a dental component, however, the ideal wrench is compact, simply constructed, inexpensive, easy to use, and disposable. It should have few, if any, relatively moving parts.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a torque wrench particularly suited for use in applying a selected maximum torque to a dental component.

It is another object of the invention to provide a torque wrench which is simple to construct, easy to use and inexpensive enough to be disposable after one use.

A further object of the invention is to provide a torque wrench suitable for use with dental implant prosthetic components which permits a predetermined maximum torque to be applied to the component during restoration.

An additional object of the invention is to provide a dental component torque wrench which deforms so as to become unusable upon the application of a selected maximum torque, but which does not break.

The objects of the invention are achieved by a wrench constructed of a single integral piece of a metal which is preferably of hexagonal cross-sectional and of a desired thickness, and which has an undercut or valley portion at a desired location in its torque arm so that the torque arm of the wrench is deformed when a predetermined torque is applied through the torque wrench to a dental implant component. Preferred aspects of the invention include the use of a diamond shaped undercut in the wrench which increases in width as it increases in depth, and then decreases in width as it decreases in depth. The diamond shaped undercut is effective in causing the wrench to deform at the desired torque without breaking off and leaving jagged surfaces and metal particles in the mouth. A first preferred embodiment of the invention provides a torque wrench which is comprised of a single rod bent through a ninety degree turn so that it provides a torque arm with the diamond-shaped undercut, and a perpendicular drive shaft which mates with the dental implant or an attachment thereto. A second embodiment of the invention provides a torque wrench which is a straight rod with an undercut therein. The top end of the straight rod is adapted for insertion into a driving tool, while the bottom end mates with the dental implant component or an attachment thereto.

Additional objects and advantages of the invention will become apparent to those skilled in the art upon reference to the detailed description taken in conjunction with the provided figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1*a* and 1*b* are respectively side and top views of a first embodiment of the torque wrench of the invention where the torque wrench has a ninety degree bend;

FIG. 2 is a diagram of a second embodiment of the ninety degree bend torque wrench of the invention; and

FIG. 3 is a cross-sectional view of a third embodiment of the torque wrench invention intended for use with a driving tool.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1*a* and 1*b*, a first preferred torque wrench **10** is shown. Torque wrench **10** is formed from a single integral shaft of annealed steel **20** (8650 alloy with Rockwell hardness of between C50 and C60) having a hexagonal cross-section (see FIG. 1*a*). In the embodiment of FIGS. 1*a* and 1*b*, the integral shaft **20** is provided with a bend **18** so that it forms a lever arm **24** and an engaging arm **12**. Because the shaft **20** has a hexagonal cross-section, the end **15** of engaging arm **12** can engage hexagonally shaped socket. Thus, dental components (not shown) which are provided with such a hex shaped socket may be engaged by the end **15** of the engaging arm **12** so that when the lever arm **24** is moved around the axis **99** of engaging arm **12**, a torque is applied to the engaged component.

It is an important feature of the invention that the wrench **10** be constructed of material so that it will deform when a predetermined force is applied to the shaft **20**. There are many such known materials and it will be recognized that the dimensions of the arms **12** and **24**, together with the properties known about the material from which it is constructed will determine at what force the shaft will deform. In this regard, it has been discovered that by providing relieved dimensions at one or more portions **32** of the shaft **20** ensures that the shaft **20** will deform reliably upon application of a predetermined force. In this manner, the torque wrench can be used to provide a torque of no more than a predetermined amount on a dental implant component which is being driven into the implant which in turn is secured in the mandibular or maxillary bone.

In the preferred embodiment of FIGS. 1*a* and 1*b*, one portion **32** of relieved dimension is shown in the lever arm **24** of shaft **20**. As shown, the relieved dimension portion **32** is generally diamond shaped such that it increases in width (as seen in FIG. 1*b*) as it increases in depth (as seen in FIG. 1*a*), and then decreases in width as it decreases in depth. It has been found that by tapering the "undercut" in at least one and preferably two dimensions, when the torque wrench is deformed by application of force in excess of the maximum desired force, the wrench will not break. Thus, no jagged edges or metal pieces will be generated

In the preferred embodiment of the invention, the shaft **20** is 0.050 inches in diameter (flat to flat) and approximately 2.4 inches long. When bent, the lever arm **24** itself is approximately 1.8 inches long, and the driving or engaging arm **12** is approximately 0.625 inches long. The relieved portion **32** is between 0.75 and 0.8 inches long and extends the entire width of the shaft **20** at the middle location **41** of the relief which is approximately 0.50 inches from the axis **99** of engaging arm **12**. At the middle location **41** of the relief, the shaft **20** is undercut a full half-width such that the diameter at location **41** is approximately 0.025 inches. As shown, the relieved portion **32** is essentially symmetrical and angles downward and upward at an angle of approximately six degrees while it widens and narrows at an angle of approximately six degrees (about three degrees on either side of a middle axis). With 8650 alloy annealed steel and the provided dimensions, the lever arm **24** will deform when approximately 22 Newton-cm torque is applied through engaging arm **12** to a dental implant. In this manner, a known maximum torque force is applied to the dental implant component, thereby guaranteeing the desired force for installation while preventing excess force which could break the implant itself, the component, or the biological interface established between the implant and bone.

Those skilled in the art will appreciate that the torque wrench **10** with the bend **18** and relieved portion **32** may be manufactured either through casting and/or milling.

Referring now to FIG. 2, a second embodiment of a ninety degree bend torque wrench **110** is seen. Torque wrench **110** is comprised of a single cylindrical shaft **120** which has a bend **118** of ninety degrees and thereby forms arms **112** and **124**. Torque wrench **110**, is shown to be wider in cross section than torque wrench **10** of FIGS. 1*a* and 1*b*, and is provided at the end of arm **112** with a hexagonal indentation or countersunk area **115** which can mate with an external hexagonal protrusion such as a hex nut (not shown). Other differences between torque wrench **110** of FIG. 2 and torque wrench **10** of FIGS. 1*a* and 1*b*are the inclusion of shaped undercut or relief **132** in the driving/engaging arm **112** rather than the preferred tapered diamond shaped relief in the lever arm.

It will be appreciated that aspects of the torque wrench of FIG. 2 can be applied to the torque wrench of FIGS. 1*a* and 1*b* and vice versa. For example, the torque wrench of FIG. 2 could utilize a relief in arm **124** (as shown in phantom) instead of or in conjunction with the provided relief in arm **112**. The use of two reliefs could be used as a safeguard to guarantee that the wrench will deform before an undesirable large torque is applied to the dental implant component. Likewise, borrowing from FIGS. 1*a* and 1*b* to FIG. 2, the relief section(s) **132** could be diamond shaped and tapering as shown in FIGS. 1*a* and 1*b*. On the other hand, torque wrench **10** could likewise be changed to apply the relief **32** in arm **12** instead of arm **24**, and the shape and location of the relief could be changed as desired.

A third embodiment **210** of the wrench of the invention is shown in FIG. 3 where shaft **220** is an unbent single unitary shaft. Thus, torque wrench **210** is not provided with a lever arm (**24** in FIG. **1**), but rather, shaft **220** is adapted to have a second engaging end **226**. The second engaging end **226** is designed to engage a driving means (e.g., handle or a motor drive) **228**. The other end of shaft **220** is designed either with a hexagonal protrusion as indicated at **214**, or alternatively with a hexagonally arranged receiving means or indentation **112** (shown in phantom). The torque wrench **210** of FIG. 3 is also provided with a portion of relieved dimension **232** which functions in the same or a similar way to the relief portions of the embodiments of FIGS. 1*a*, 1*b*, and 2. It should be appreciated that just as torque wrench **210** is provided with a second engaging end **226** for engaging a motor drive or the like **228**, the lever arm of the torque wrenches **10** and **110** of FIGS. 1*a*, 1*b*, and 2 can be provided at the end of their lever arms with

means for engaging a handle or other driving mechanism.

The advantages of the torque wrenches of the invention are that they are simple and extremely inextensive to manufacture, easy to use, and very reliable. In addition, the torque wrenches with the tapered undercut are less likely to break and leave jagged edges and metal fragments. The wrenches are intended to provide a selected maximum torque to a dental implant component, at which point they deform and are discarded after one use.

There have been illustrated and described herein torque wrenches for dental implant components. While particular embodiments of the invention have been described, it is not intended that the invention be limited thereto, as it is intended that the invention be as broad in scope as the art will allow and that the specification be read likewise. Thus, while a particular steel alloy was described as the preferred material of the invention, it will be appreciated that other materials, or other alloys could be utilized. Likewise, while particular dimensions were described in the preferred embodiment, including the diameter of the steel, the distance from the relief to the curve in the steel, the depth of the relief, etc., it will be appreciated that other dimensions could be utilized with the exact same material to provide the same maximum torque. With other materials, clearly, other dimensions could be utilized. Also, if a different maximum torque were required, other dimensions, shapes, and/or materials could be utilized to obtain the same. It will therefore be appreciated by those skilled in the art that yet other modifications could be made to the provided invention without deviating from its spirit and scope as so claimed.

We claim:

1. A torque wrench for a dental implant component, comprising:

a single integral shaft having a first end, a second end, and a middle portion having an undercut therein, said first end having a first engaging means for engaging said dental implant component, said first engaging means having one of an outer surface which is hexagonal in cross-section and an indentation which is hexagonal in cross-section, wherein said shaft is constructed of a preselected material and dimensioned to a first preselected cross-sectional thickness, and said undercut being located at a preselected location along said shaft and undercutting said shaft to at least one preselected cross-sectional thickness such that said shaft deforms substantially and noticeably without breaking at said undercut when a predetermined torque is applied through said shaft to said dental implant component.

2. A torque wrench according to claim 1, wherein:

said middle portion of said shaft has a substantially ninety degree bend therein with a first portion of said shaft from said bend to said second end thereby acting as a lever arm.

3. A torque wrench according to claim 2, wherein:

said undercut is located in said lever arm.

4. A torque wrench according to claim 3, wherein:

said undercut is generally diamond shaped and increases in width as it increases in depth and then decreases in width as it decreases in depth.

5. A torque wrench according to claim 4, wherein:

said single integral shaft is hexagonal in cross section.

6. A torque wrench according to claim 1, wherein:

said single integral shaft is hexagonal in cross section.

7. A torque wrench according to claim 1, wherein:

said undercut is generally diamond shaped and increases in width as it increases in depth and then decreases in width as it decreases in depth.

8. A torque wrench according to claim 5, wherein:

said middle portion of said shaft has a substantially ninety degree bend therein with a first portion of said shaft from said bend to said second end acting as a lever arm, and with a second portion of said shaft from said bend to said first end acting as a driving arm.

9. A torque wrench according to claim 8, wherein:

said preselected material is alloy 8650 annealed steel,

said undercut is located in said lever arm,

said first preselected cross-sectional thickness is approximately 0.050 inches in diameter,

said lever arm is approximately 1.8 inches long,

said driving arm is approximately 0.625 inches long,

said undercut is approximately 0.775 inches long and said undercut starts at a first location and angles downward at approximately six degrees and widens at approximately six degrees as it angles downward to a middle location having said at least one second preselected cross-sectional thickness, and angles upward at approximately six degrees and widens at approximately six degrees as it angles upward to a second location, wherein said second preselected cross-sectional thickness is approximately 0.025 inches in diameter, and said middle location is approximately 0.5 inches from said bend, and said predetermined torque is approximately 22 Newton-cm.

10. A torque wrench according to claim 9, wherein:

said single integral shaft and said outer surface of said first engaging means are hexagonal in cross-section.

11. A torque wrench according to claim 5, wherein:

said outer surface of said first engaging means is hexagonal in cross-section.

12. A torque wrench according to claim 1, wherein:

said first engaging means has an indentation which is hexagonal in cross-section.

13. A torque wrench according to claim 1, wherein:

said second end has a second engaging means for engaging a drive means.

14. A torque wrench according to claim 1, wherein:

said undercut increases in width as it increases in depth and then decreases in width as it decreases in depth.

15. A torque wrench according to claim 1, wherein:

said undercut is generally diamond shaped.

16. A torque wrench for a dental implant component, comprising:

a single integral shaft having a first end, a second end, and a middle portion having an undercut therein, said first end having a first engaging means for engaging coupling means coupled to said dental implant component upon which a torque is to be applied, wherein said shaft is constructed of a preselected material and dimensioned to a first preselected cross-sectional thickness, and said undercut being located at a preselected location along said shaft and undercutting said shaft to at least one preselected cross-sectional thickness such that said shaft deforms substantially and noticeably without breaking at said undercut when a predetermined

torque is applied through said shaft to said dental implant component.

17. A torque wrench according to claim **16**, wherein: said middle portion of said shaft has a substantially ninety degree bend therein with a first portion of said shaft from said bend to said second end thereby acting as a lever arm.

18. A torque wrench according to claim **16**, wherein: said undercut increases in width as it increases in depth and then decreases in width as it decreases in depth.

19. A torque wrench for a dental implant component, comprising:

a single integral shaft having a first end, a second end, and a middle portion having an undercut therein, said first end having a first engaging means for engaging said dental implant component, said first engaging means having one of an outer surface which is hexagonal in cross-section and an indentation which is hexagonal in cross-section, wherein said shaft is constructed of a preselected material and dimensioned to a first preselected cross-sectional thickness, and said undercut being located at a preselected location along said shaft and undercutting said shaft to at least one preselected cross-sectional thickness such that said shaft deforms at said undercut when a predetermined torque is applied through said shaft to said dental implant component, said undercut increasing in width as it increases in depth and then decreasing in width as it decreases in depth.

20. A torque wrench according to claim **19**, wherein: said undercut is generally diamond shaped.

* * * * *

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/789,630	02/27/2004	Dohn J. Trempala	KNOXX.024C2	7659

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BARRETT, SUZANNE LALE DINO	

ART UNIT	PAPER NUMBER
3676	

DATE MAILED: 11/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/789,630	TREMPALA, DOHN J.	
	Examiner	Art Unit	
	Suzanne Dino Barrett	3676	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 September 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7 and 24-38* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *31* is/are allowed.

6)☒ Claim(s) *1-7,24-30,32,33,36,38* is/are rejected.

7)☒ Claim(s) *34,35 and 37* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *9/15/06*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claim 33 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In claim 33, it is unclear whether Applicant intends to claim the combination of a locking cap and fire department connection or the subcombination locking cap alone. While the preamble sets forth the subcombination locking cap alone, with the intended use on a fire department connection, the body of the claim later recites "sized and configured to be received by...fire department connection" which would lead one to infer that the combination is intended to be claimed. Since the claim is unclear as it is, if Applicant intends to claim the combination, the combination must be positively claimed.

Claim Objections

3. Claim 28 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 28 recites locking

cap limitations which do not further limit the key of claims 24 and 27 from which it depends.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1-4,32,36,38 are rejected under 35 U.S.C. 102(b) as being anticipated by Hoshino 5,419,650. Hoshino teaches a plug 21 and face plate 32 cap expander assembly for a pipe end 50 comprising a threaded actuator 70, having a configured head with a conventional female slot to receive a conventional male tool member, and attached to a tapered spreader member 41 which expands the plug member 21 into frictional engagement with the pipe walls 50 when locked. The plug comprises a front surface (at 51a (bottom) in Fig.3), rear surface (at 21a (top) in Fig.2), side outer surface (at 21a in Fig.1) and a slot 22 (fig.1) extending longitudinally between the front and rear and radially between the side and a relief opening (the top plane of slot 22 corresponding to the thickness of the wall of plug member 21, i.e. the entrance of the open-ended slot) and further, wherein the inside of the plug forms a channel therethrough (coextensive with the surface 23,24,25 defining the perimeter of the inside wall of plug 21 in Fig.1) and radially displaced from the relief opening (top plane of slot 22), which receives a spreader member 41 and the actuator 70. With respect to new

claim 32, the channel coextensive with surface 23 in Fig. 1 is considered "radially displaced" from the relief opening which is interpreted as the top plane portion of slot 22 corresponding to the thickness of the outer side wall of plug 21.

6. Claims 24-28 are rejected under 35 U.S.C. 102(b) as being anticipated by Strauch 5,704,261. Strauch et al teach a key/tool member 3 comprising a head 2 having a raised portion on the distal tip thereof to engage a structure, a handle shaft 3,4, defining a deformation zone without a relief cut which, upon torqueing of the tool beyond a predetermined amount, deforms plastically (col. 4, lines 10-24; claims 10,12). It would have been obvious to one of ordinary skill in the art to utilize such a tool/key as taught by Strauch et al, on a locking cap actuator such as that previously discussed with respect to Hoshino. It is noted that the preamble recitation of a "locking cap" key does not impart structure to the key and is considered intended use of the key and not accorded patentable weight. Furthermore, the limitation of claim 28 does not further limit the key structure and is not accorded patentable weight.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 7 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoshino 5,419,650 in view of Borenstein 4,651,771.

With respect to claim 7, Hoshino teaches a plug member on a locking cap but fails to specify the material used. Borenstein et al teach, in col. 4, line 65, the use of brass among other suitable materials for a plug lock member. It would have been obvious to one of ordinary skill in the art to modify the material of Hoshino by providing brass as taught by Borenstein et al as an obvious matter of design choice.

With respect to claim 33, Hoshino teaches the pipe lock cap expander arrangement described above but fails to teach the use of such an expander cap in combination with a fire department connection. Borenstein teaches a fire department connection in a fire hydrant having a pipe 18 with a locking cap 28 therefor having a female patterned pentagonal head 46 which is engaged by a correspondingly patterned tool head 50 to remove the locking cap from the pipe 18. It would have been obvious to one of ordinary skill in the art to combine the teachings of Hoshino and Borenstein by providing a locking cap with the pipe cap expander arrangement taught by Hoshino on a fire department connection pipe taught by Borenstein as an obvious matter of design choice in substituting one type of pipe cap for another.

9. Claims 5,6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoshino '650 in view of Lanham 6,017,177. Lanham teaches the use of a bolt head 30/35 (Fig. 1) having a female cloverleaf pattern consisting of seven apexes (35) and eight wavy grooves connecting the apexes, actuated by a similarly configured key head 20/25. It would have been obvious to one of ordinary skill in the art to modify the female pattern bolt head 22 of Hoshino by providing a cloverleaf configured bolt head and accompanying key head as taught by Lanham to enhance the security of the lock.

10. Claims 24,29 are further rejected under 35 U.S.C. 103(a) as being unpatentable over Stehling '501 in view of Strauch et al '261. Stehling teaches a key member having a hole portion (at 40) which is capable of receiving a key ring. It would have been obvious to one of ordinary skill in the art to modify the key of Stehling by providing a deformation zone as taught by Strauch et al as an obvious matter of design choice in enhancing the security of the lock cap.

11. Claims 24,30 are further rejected under 35 U.S.C. 103(a) as being unpatentable over Borenstein '771 in view of Patterson '831. Borenstein et al teach a key member comprising a T-shaped cross member configuration at one end (49/66) with a hole 66 disposed in one cross member. It would have been obvious to one of ordinary skill in the art to modify the key of Borenstein et al by providing a deformation zone as taught by Strauch et al as an obvious matter of design choice in enhancing the security of the lock cap.

Allowable Subject Matter

12. Claim 31 is allowed.

The limitation in claim 31 requiring the channel to be disposed between the slot side surface and the relief opening defines over Hoshino which clearly teaches the channel (portion coextensive with surface 23 in Fig.1) radially disposed after the slot 22 and relief opening (top plane of slot 22).

13. Claims 34,35,37 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The channel of Hoshino intersects the entire slot and not just a portion of the slot as set forth in claim 34. The slot of Hoshino does not extend through "two sides" of the channel as set forth in claim 35 and further, does not teach that the face plate and plug are secured by fasteners (plural), since Hoshino teaches that they are secured only by the fastener 70.

Response to Arguments

14. Applicant's arguments filed 9/15/06 have been fully considered but they are not persuasive. As set forth above, the previous rejections and objections have been maintained.

Regarding the rejection of claim 33 under 35 U.S.C. 112, the Examiner respectfully disagrees with Applicant's arguments. The very fact that Applicant argues both the combination (Remarks, pages 7, lines 16-24) and the subcombination (page 7, last line-page 8, lines 1-5) is evidence of the ambiguity with respect to the scope of the claim. Accordingly, this rejection is maintained.

Regarding the objection to claim 28 under 37 CFR 1.75 (C), the Examiner respectfully disagrees with Applicant's arguments. The amendment to claim 28 does not obviate this objection. The scope of the claim with respect to the claimed key cannot be

ascertained since the key structure is dependent on structure (the cap recessed pattern) which is not positively claimed. Accordingly, this objection still stands.

Regarding the prior art rejections, with respect to applicant's arguments against Hoshino presented on page 9 of the remarks, the examiner respectfully disagrees. It is maintained that the relief opening is co-extensive with the top surface of the plug and therefore within the plug structure. Furthermore, it is also maintained that the slot 22 does extend radially between the side surface (21a in Fig.1) and a portion of the relief opening, regardless of the fact that the two surfaces extend normal to each other at the top.

With regard to Applicant's arguments against Strauch, it is maintained that a screwdriver bit is considered a "key" type tool and therefor anticipates the claimed structure.

Regarding Borenstein, it is maintained that the combination with Hoshino is proper since the intended use of the device on a fire dept connection would have been obvious to one of ordinary skill in the art.

With respect to Stehling and Strauch, it is maintained that one of ordinary skill in the tool art would have looked to other torque tools to provide a torque limiting means as needed for the desired function.

Further, Lanham clearly teaches enhancing security by providing various key patterns.

Accordingly, Applicant's arguments are not persuasive and the rejections stand.

Conclusion

15. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Suzanne Dino Barrett whose telephone number is 571-272-7053. The examiner can normally be reached on M-Th 8:30-7:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Glessner can be reached on 571-272-6843. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Suzanne Dino Barrett
Primary Examiner
Art Unit 3676

sdb

PTO/SB/08a (08-03)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	10789630
Filing Date	2004-02-27
First Named Inventor	Dohn J. Trempala
Art Unit	3676
Examiner Name	Suzanne Lale Dino Barrett
Attorney Docket Number	KNOXX.024C2

U.S.PATENTS

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6698261		2004-03-02	Trempala	
	2	6907760		2005-06-21	Trempala	
	3	6802338		2004-10-12	Istre, Jr.	
	4	6694783		2004-02-24	Trempala	
	5	6550294		2003-04-22	Garguilo	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	10789630
Filing Date	2004-02-27
First Named Inventor	Dohn J. Trempala
Art Unit	3676
Examiner Name	Suzanne Lale Dino Barrett
Attorney Docket Number	KNOXX.024C2

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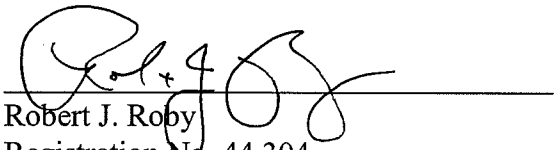
X. RELATED PROCEEDINGS APPENDIX

None



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